

AD-A238 452



Donohue



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Monitoring Well Installation and Groundwater Sampling and Analysis Plan

Prepared for:

**U.S. Army Training
Reserve-84th Division
Milwaukee, Wisconsin**

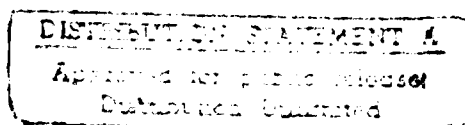


Project No. HA01005-8P

Drawing No. 47-018-2041

**Includes: Site Health and Safety Plan
Technical Specifications and Agreement**

November 1988



91-04049



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MONITORING WELL INSTALLATION
AND
GROUNDWATER SAMPLING AND ANALYSIS PLAN
AT THE
USARC TRAINING RESERVE - 84TH DIVISION
MILWAUKEE, WISCONSIN

Project No. HA01005-8P
Drawing No. 47-018-2041

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Prepared by
Donohue & Associates, Inc.
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November, 1988

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Title

A	Well Purging and Sample Collection Logs
B	Well Construction Diagram
C	Well Development Form

RP/MILWUTA/AA2

1.0 OBJECTIVES

The objectives of this project work plan are to ensure that monitoring well construction and groundwater sampling and sample custody procedures employed at the 84th U.S. Army Reserve's Training Center are consistent with Donohue's standard guideline and specifications prior to the initiation of onsite activities. This plan will:

- Document sample frequency, depth, and the geotechnical testing requirements required to properly evaluate site geology.
- Describe procedure for monitoring well installation and development.
- Describe the equipment and sampling methods that will be used to obtain groundwater and soil samples.
- Describe precautions to be taken during collection of groundwater samples which will minimize potential contamination.
- Outline procedures for documentation of field activities.
- Describe the methodology employed for sample labeling, packaging, storage, shipping, and chain-of-custody procedures.

2.0 SUMMARY OF FIELD ACTIVITIES

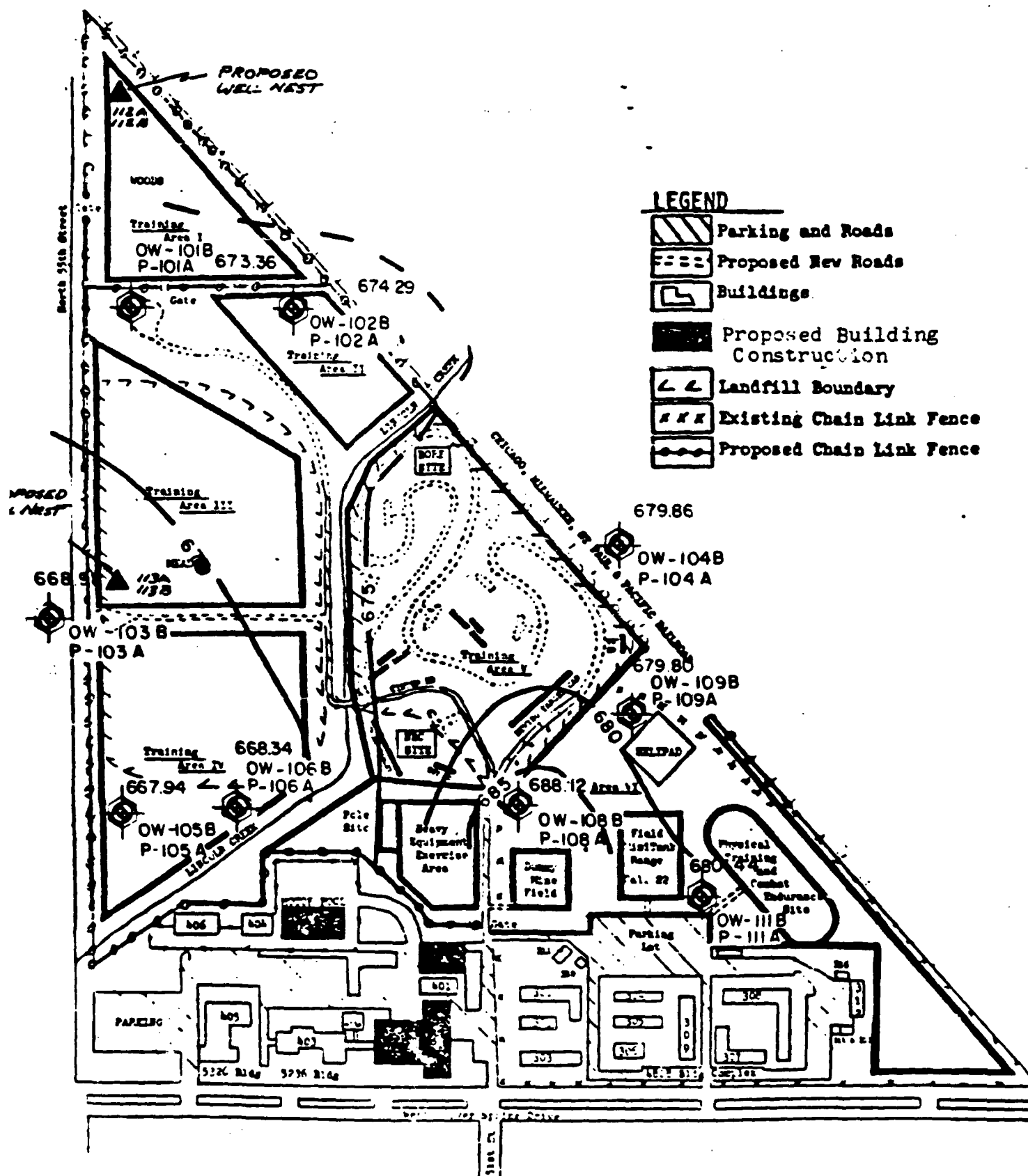
Four groundwater monitoring wells will be installed at two locations designated as 112A - 112B, AND 113A - 113B, onsite. Each well nest will be comprised of one 20-foot observation well and one 45-foot piezometer. Following the development of each newly-installed well, twelve new and existing wells will be sampled to determine groundwater quality. Approximate well locations are given in Figure 1.

2.1 Soil Samples

Soil samples will be collected at 5-foot depth increments in each piezometer. Soil samples shall be described by a qualified geologist or geotechnician according to the U.S.C.S. Soil Classification Standards. Soil types will be documented on a soil boring log to include the boring (or well) identification number, location, method of drilling and sampling, blow counts, and sampling depths.

Soil samples from borings in which observation wells are installed will only be collected from the screened depth interval, as determined by the onsite geologist. These samples will also be described according to U.S.C.S. Soil Classification Standards and documented on a boring log.

FIGURE 1



Donohue

13590 OCB
MAR 64 985

GROUNDWATER CONTOUR MAP

GROUNDWATER INVESTIGATION
MILWAUKEE USAR CENTER COMPLEX AND TRAINING AREA
MILWAUKEE, WISCONSIN

Engineers & Architects

P-2

Verification of soil classifications will be made during this boring program by analyzing selected soil samples. Laboratory analysis may consist of grain size analyses and Atterberg Limits as determined by the site geologist. The volume of soil material obtained from each sampling depth must be sufficient to allow for geotechnical testing as required.

2.2 Drilling Procedure

Drilling will be accomplished by using a 4 inch (I.D., minimum) hollow-stem auger. Geotechnical soil samples will be obtained by driving a standard 2-inch split spoon sampling device into the soil at the appropriate depth.

2.3 Well Installation Soil Sampling Procedure

Geotechnical soil samples will be taken at 5-foot intervals until the total depth of the well is reached, unless a noticeable change in soil stratigraphy necessitates more frequent sampling. All soil samples will be visually classified by onsite personnel according to U.S.C.S. Standards.

° Well Depth Criteria

Observation wells will be installed to a total depth of 20 feet, and intermediate piezometers to 45 feet. At a particular location, the top of the screen in the piezometer shall lie at an elevation 20 feet below the bottom of the screen in the adjacent observation well.

3.0 GROUNDWATER SAMPLING PROTOCOL

3.1 Introduction

This section describes protocols for collection of groundwater samples. The samples will be used to determine groundwater quality. Groundwater samples will be obtained from eight existing wells, and the four newly monitoring wells once they have been properly developed. Twin City Testing will perform well development activities in accordance with Donohue specifications. At the present time, it is anticipated that two sampling events will be performed at least 60 days apart.

Table 1 presents a listing of the analytes, analytical methods, and sample containers and preservatives to be used during this project. Quality Assurance/ Quality Control requirements are given in Table 2. Each new well will be analyzed for each of the parameters shown. Groundwater samples from existing wells will only be analyzed for volatile organics. Table 3 provides a listing of organic analytes to be determined during this program. Indicator parameters, inorganic analytes and other parameters to be determine are summarized in Table 4.

TABLE 1

ANALYTICAL METHODS AND GROUNDWATER SAMPLING REQUIREMENTS
84th U.S. Army Reserve's Training Center

Analyte	Well ** Type	Detection Limit	EPA Method Number/Reference	Sample Container	Preservative(s)	Holding Time
Color	P, E	-	Field Observation	Glass Jar	None	Analyze Immediately
Odor	P, E	-	Field Observation	Glass Jar	None	Analyze Immediately
Turbidity	P, E	-	Field Observation	Glass Jar	None	Analyze Immediately
pH	P, E	-	Field Observation	Glass Jar	None	Analyze Immediately
Conductivity	P, E	-	Field Observation	Glass Jar	None	Analyze Immediately
<u>DISSOLVED METALS</u>						
Arsenic	P	1 ug/l	206.3/1	250 ml HDPE Bottle	1:1 HNO ₃ to pH <2	6 Months
Barium	P	200 ug/l	208.1/1	250 ml HDPE Bottle	1:1 HNO ₃ to pH <2	6 Months
Boron	P	0.1 mg/l	212.3/1	250 ml HDPE Bottle	None	6 months
Cadmium	P	1 ug/l	213.2/1	250 ml HDPE Bottle	1:1 HNO ₃ to pH <2	6 Months
Chromium	P	2 ug/l	218.2/1	250 ml HDPE Bottle	1:1 HNO ₃ to pH <2	6 Months
Lead	P	2 ug/l	239.2/1	250 ml HDPE Bottle	1:1 HNO ₃ to pH <2	6 Months
Mercury	P	0.2 ug/l	245.2/1	250 ml HDPE Bottle	1:1 HNO ₃ to pH <2	28 days
Iron	P	50 ug/l	236.1/1	250 ml HDPE Bottle	1:1 HNO ₃ to pH <2	6 Months
<u>OTHER</u>						
Nitrate+Nitrite-Nitrogen	P	0.05 mg/l	353.2/1	250 ml Glass Bottle	1:1 H ₂ SO ₄ to pH <2, 4°C	28 Days
Ammonia-Nitrogen	P	0.10 mg/l	350.1/1	250 ml Glass Bottle	1:1 H ₂ SO ₄ to pH <2, 4°C	28 Days
Sulfate	P	2 mg/l	375.2/1	1000 ml HDPE Bottle	4°C	28 Days
Chloride	P	0.5 mg/l	325.2/1	1000 ml HDPE Bottle	None	28 Days

** P Denotes proposed well; E denotes existing well

TABLE 1

ANALYTICAL METHODS AND GROUNDWATER SAMPLING REQUIREMENTS
84TH U.S. Army Reserve's Training Center
(Continued)

Analyte	Well** Type	Detection Limit	EPA Method Number/Reference	Sample Container	Preservative(s)	Holding Time
Total Alkalinity	P	5 mg/l	310.2/1	1000 ml HDPE Bottle	4°C	14 Days
Hardness	P	5 mg/l	130.1/1	.750 ml HDPE Bottle	1:1 HNO ₃ to pH <2	6 Months
COD	P	5 mg/l	410.4/1	250 ml Glass Bottle	1:1 H ₂ SO ₄ to pH <2, 4°C	28 Days
BOD	P	2 mg/l	405.1/1	1 liter HDPE Bottle	None	48 Hours
<u>ORGANICS</u>						
Volatiles Organics	P,E	1-5 ug/l*	624: Vials, Teflon Septa, No Headspace	(2) 40 ml glass	4°C	14 Days

References:

1. EPA-600/4-79 020 revised 1983. "Methods for Chemical Analysis of Water and Wastes"
2. 40 CFR Part 136. Federal Register, October 26, 1984.

*Varies by compound, refer to method.

** P Denotes proposed well; E denotes existing well

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TABLE 2

QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS
84th U.S. Army Reserve's Training Center

<u>Well Type</u>	<u># Field Samples</u>	<u># Field Blanks</u>	<u># Trip Blanks</u>	<u>#Field Duplicates</u>
Existing	8	1	0	0 *
Proposed	4	1	1	1 *

* One field duplicate taken during each event. Second event field duplicate will be from well exhibiting detectable volatile organics in first event.

Sample Containers for Each
Field Sample, Blank, Duplicate

<u>Analyte(S)</u>	<u>Container</u>
1. Metals, Hardness	1-liter HDPE bottle with 1:1 HNO ₃ to pH <2
2. Sulfate, chloride, BOD, alkalinity	1-liter HDPE bottle cool to 4°C
3. Ammonia, COD Nitrate + nitrite	1-250 ml glass bottle, 1:1 H ₂ SO ₄ to pH <2
4. Volatile Organics	(2) 40 ml glass vials with Teflon septa, no headspace, 4°C

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TABLE 3

ORGANIC ANALYTES
84th U.S. Army Reserve's Training Center

<u>CAS Number</u>	<u>Donohue Analytical Detection Limit (ug/l)</u>	<u>Volatiles</u>
74-87-3	<2	Chloromethane
74-83-9	<2	Bromomethane
75-01-4	<2	Vinyl Chloride
75-00-3	<2	Chloroethane
75-09-2	<1	Methylene Chloride
67-64-1	<5	Acetone
75-15-0	<10	Carbon Disulfide
75-35-4	<1	1,1-Dichloroethene
75-34-3	<1	1,1-Dichloroethane
156-60-5	<1	Trans-1,2-dichloroethene
67-66-3	<1	Chloroform
107-06-2	<1	1,2-Dichloroethane
78-93-3	<10	2-Butanone
71-55-6	<1	1,1,1-Trichloroethane
56-23-5	<1	Carbon Tetrachloride
106-05-4		Vinyl Acetate
75-27-4	<1	Bromodichloromethane
78-87-5	<1	1,2-Dichloropropane
10061-02-6	<1	Trans-1,3-Dichloropropene
79-01-6	<1	Trichloroethene
124-48-1	<1	Dibromochloromethane
79-00-5	<1	1,1,2-Trichloroethane
71-43-2	<1	Benzene
10061-01-5	<1	Cis-1,3-Dichloropropene
110-75-8	<1	2-Chloroethylvinylether
75-25-2	<1	Bromoform
591-78-6	<10	4-Methyl-2-Pentanone
108-10-1	<25	2-Hexanone
127-18-4	<1	Tetrachloroethene
79-34-5	<1	1,1,2,2-Tetrachloroethane
108-88-3	<1	Toluene
108-90-7	<1	Chlorobenzene
100-41-4	<1	Ethylbenzene
100-42-5	<1	Styrene
	<2	Total Xylenes

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TABLE 4

FIELD PARAMETERS AND INORGANIC ANALYTES
84th U.S. Army Reserve's Training Center

Indicator Parameters:

BOD
Alkalinity
COD
Hardness
Ammonia/Nitrogen

Field Parameters:

Temperature
Conductivity
pH
Turbidity
Color
Odor

Public Welfare Standards:

Chloride
Dissolved Iron
Sulfates

Public Health Standards:

Nitrate and Nitrite - Nitrogen

Other Dissolved Metals to Include:

Arsenic
Barium
Boron
Cadmium
Chromium
Lead
Mercury

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3.2 Purging of Monitoring Wells

Following proper construction, installation, and development of the monitoring wells, purging must be conducted prior to sampling to ensure the collection of a representative groundwater sample. For wells with rapid recovery rates, a minimum of five well volumes will be removed. However, low-yield wells, which do not recharge upon purging, will be pumped dry and then sampled as soon as they recharge.

Pumps to be used during the purging process will be fitted with a foot valve located at the water intake in the pump. This will prevent purged water from siphoning back into the well.

Before, during and after completion of purging, the chemical and physical characteristics of the water removed at each well will be determined to include; turbidity, color, odor, conductivity, pH, and temperature. These parameters must be constant (+10%) before the well is considered properly purged. All of the information collected during the purging process will be recorded on a well purging and sample collection log as shown in Appendix A.

3.2.1 pH Measurement

As soon as a sample is collected, groundwater pH will be measured. This will be accomplished by using a digital temperature compensating pH meter. Prior to measurement, the pH will be standardized using fresh buffer solutions of 4.0, 7.0, and 10.0.

3.2.2 Conductivity Measurement

Specific conductance will be measured by a conductivity meter with temperature compensation. Daily calibration of the conductivity meter will occur throughout the field investigation. Calibration is accomplished through the insertion of the conductivity probe into a standard 1413 micromhos solution. This procedure will be done prior to groundwater monitoring and sampling.

3.3 Groundwater Sample Collection and Order

Groundwater wells will be sampled immediately after purging and no later than 24 hours following purging with the exception of those wells which take longer than 24 hours to recover. The sampling device used for groundwater collection is a teflon bailer attached to a nylon rope or stainless steel cable. The first several bailer volumes retrieved from the well will be discarded prior to following sample collection. Based on past data, wells will be sampled in the following order (least contaminated to most contaminated): 105A/B, 106A/B, 113A/B, 101A/B, 102A/B, and 112A/B.

3.3.1 Groundwater Sampling Procedure

After proper construction, installation, and development of the wells, groundwater sampling procedures will begin. However, before a sample is collected from a well, the water level will be measured and recorded. The well will then be pumped or bailed with precleaned (decontaminated) equipment to remove a quantity of water equal to at least five times the submerged volume of the casing. If the well does not recharge fast enough to permit the removal of five casing volumes, the well will be pumped or bailed dry, and then sampled as soon as sufficient recharge has occurred.

Samples for chemical analysis will be collected in a bottom emptying teflon or stainless steel bailer. Immediately after use, all equipment used for sampling will be rinsed thoroughly with Liquinox solution, followed by a double distilled water rinse. This cleaning procedure will occur between each sampling locations. Sampling equipment which may be used during sampling activities and will require decontamination include measuring tapes, pumps, tubing, and a rope. Each bottom-discharge bailer will be precleaned off-site, wrapped with aluminum foil, and stored until use in a dedicated storage tube.

3.3.2 Sampling Procedure for Existing Well

- ° Prior to sample collection, remove stagnant water by purging all wells.
- ° To determine the volume of water to be purged from each well, if possible, measure the depth to the static water level and depth to the bottom of the well from the top of pipe. Use a fiberglass tape. Between measurements at each well, rinse the tape several times with distilled water.
- ° Based on the depth to water, the total depth of the well and the diameter of the well, the gallons of water standing in the well (well volume) shall be calculated using the following formula:

$$1 \text{ well volume} = 3.14 d^2/4 \times H \times 7.48$$

Where:

d = diameter of well (feet) (2-inch I.D.=0.167 ft)

H = height of water (feet) from well bottom

If the well volume cannot be determined, use the following procedures to sample existing monitoring wells:

- ° Sample will be drawn directly into precleaned Teflon or stainless steel bailer for VOCs.
- ° VOC sampling procedures shall be consistent with those used at other groundwater well locations.
- ° Samples for other analyses shall be drawn directly into sample jars.
- ° Appropriate decontamination, handling, labeling, and chain-of-custody procedures shall follow sampling.

If the pump is inoperable, determine if the well can still be sampled. If sampling is possible, obtain sample as close as possible to well head. If possible, remove five well casing volumes prior to sampling.

3.3.3 Field Sample Splitting

Groundwater samples will be immediately split in the field for specific chemical analysis. Groundwater samples to undergo analysis for dissolved metals will be field-filtered using a 0.45 micron filter and a positive pressure technique. Samples to undergo analyses for volatile organic compounds will not be filtered.

All water samples will be collected in the appropriate bottles. Preservatives will be added only to samples to undergo analysis for dissolved metals. Bottle and preservative requirements have been summarized in Table 2.

Groundwater sample may be analyzed for one or more of the following as shown in Table 1: (1) Physical parameters to include color, temperature, color, turbidity, and specific conductance; (2) Volatile Organics (including Xylene) by EPA Method 5030/8240; (3) Dissolved Metals including arsenic, barium, boron, cadmium, chromium, iron, lead, and mercury; and (4) Primary and secondary parameters to include nitrate + nitrite-nitrogen, ammonia-nitrogen, sulfate, chloride, total alkalinity, hardness, biochemical oxygen demand (BOD), and chemical oxygen demand (COD).

Analytical methods are given in Table 1. Detection limits will be consistent with Federal Drinking Water Standards where applicable and will be acceptable to Wisconsin DNR. It is possible that it may be necessary to use AA Furnace Methods instead of EPA Method 6010 to achieve some of these detection limits.

VOC Sampling Procedure

- ° Water samples for volatiles will not be composites. These samples will be obtained by the following procedure.

- ° Gently fill each 40 ml VOA vial with sample until overflowing, in a manner such that no air bubbles become entrapped.
- ° Place septum on top of the vial with white teflon side in toward the sample and screw on the cap. Always keep the vial submerged. Invert vial and inspect for bubbles.
- ° If air bubbles persist, discard sample and repeat process.
- ° Collect two vials of VOC samples at each location.
- ° Attach appropriate labels, tags, custody information and store sample in a cooler. Log sample collection. Care must be taken to avoid freezing the sample.

3.3.4 QA/QC Samples

For volatile organic analysis, quality control will be accomplished through the collection of field blanks and field duplicates. One (1) duplicate water sample, one trip blank and one (1) field blank will be obtained at each sampling event. After the volatile organic data from the first event is evaluated, the location for the field duplicate for the second event will be chosen. A well location where detectable volatile organics reported will be selected. Duplicate precision will be assessed by using the Relative Percent Difference (RPD) statistic:

$$RPD = \frac{A - B}{A + B} \times 200$$

Where:

A = Concentration of Analyte in Sample
B = Concentration of Analyte in Duplicate

Note the breakdown of Quality Assurance/Quality Control samples given in Table 2. The definitions of each QA/QC samples is described in sections 3.4.1, 3.4.2, and 3.4.3.

3.4.1 Field Blanks

Field blanks will consist of rinsates. Rinsates taken for samples other than volatile organics will be collected prior to obtaining any other samples at each groundwater sampling location. Field blank rinsate samples will be collected by running deionized water through the bailer and collecting the water in a precleaned bottle.

3.3.4.2 Trip Blanks

Trip blanks will be prepared to assess the degree and type of accidental contamination by volatile organics that may result from sample collection and shipment procedures. Prior to the field team's departure from the Donohue Office, two 40 ml volatile vials will be filled completely with reagent grade water. The vials will accompany the package of empty vials to be used for volatile field sample collection into the field. Each trip blank will be opened once in the field. They will then be recapped, properly packed with the site field samples, and sent to the QA and QC laboratory for analysis.

3.3.4.3 Duplicate Samples

Duplicate groundwater samples will be collected for analysis according to QA/QC breakdown given in Table 2. They will be obtained at the same time and using the same methods as employed during the collection of the field samples. In addition, sample splits will be collected for metals analysis.

Unique sample numbers will be assigned to the split and duplicate sample sets sent to the QC laboratory to aid in their disguise.

3.3.5 Bottles and Preservatives

Prewashed decontaminated sample bottles will be used for groundwater sampling. Glass 40 ml vials with teflon septums will be used to store water samples for volatile organics testing. Groundwater samples for all other analysis will be collected in 250 ml liter glass or polyethylene (HDE) bottles as shown in Table 2.

Each bottle containing a groundwater sample must be appropriately identified, using an adhesive label attached to it (a tag may also be necessary). The addition of chemical preservatives (HNO_3 and H_2SO_4) will be necessary for all water samples collected for specified analytes as shown in Table 2. Preservatives will be prepared by Donohue Analytical prior to the initiation of the sampling program.

Table 1 also summarizes the containers to be used for each sample type, as well as the preservatives and holding times for samples taken at this site. No preservatives will be used for samples to undergo testing for volatile organics. Water samples require refrigeration as close as possible to 4°C following collection.

3.3.5.1 Addition of Preservatives

Glass vials with 4 ml capacity and teflon lined screw caps, will be filled with 3 ml of metals grade 1:1 nitric acid or sulfuric acid. Sample bottles requiring the addition of a preservative

will be filled to within 1/4-inch of full with the sample and then the entire contents of the HNO_3 (H_2SO_4) vial added before the packaging of the sample for shipment to the lab. The laboratory sample custodian will check that the pH of the preserved sample is less than 2, or additional acid will be added.

Note: Chemical preservatives must also be added to all field duplicates and blanks.

Each bottle filled with sample must be labeled. A notation of the preservative added should be made in the field book.

3.3.6 Packaging and Shipping

Only high quality plastic coolers and/or metal coolers will be used. Styrofoam coolers, boxes, or foam lined fabric coolers are not acceptable. Bottles will be placed upright in coolers. Styrofoam packing beads (or other suitable packing material) will be placed in the cooler bottom. More styrofoam packing beads will be added to cover bottles. Frozen blue ice packs will be placed in ziplock bags and put around samples, but will not come in direct contact with the bottles. Additional styrofoam beads will be added to fill the cooler. The cooler drain will be taped shut with fiber strapping tape.

Place the original chain-of-custody form in a ziplock bag and tape to the underside of the cooler lid with fiber strapping tape. Tape the lid of cooler with fiber strapping or duct tape. Place two (or more) Donohue custody seals (numbers recorded on the custody form) on the cooler over the cooler latch(es) and at the back of the cooler. Three inches (wide) of clear tape will cover the seals. The seal will be signed and dated by the person sealing the cooler.

Donohue Analytical will be informed by phone of the number of samples, analyses required, and expected time of courier arrival. Samples will be delivered to the lab the same day as collected by the field team. Once samples arrive at Donohue, the lab sample custodian will then break and record the seal condition, inventory the samples, sign the custody form, and inform the Donohue Project Manager of any discrepancies between bottles, labels, tags, and custody documentation.

4.0 SAMPLING PROGRAM ORGANIZATION

4.1 Documentation of Sampling Events

Bound field and laboratory notebooks with sequentially numbered pages will provide the means for recording data collection activities performed both at the site and in the laboratory. As such, entries will be described in as much detail as possible so that the situation can be reconstructed without reliance upon memory.

The cover of each notebook will contain:

84th U.S. Army Reserve Training Center
Milwaukee, Wisconsin
Assigned Activities
Start and End Dates
Book Number

Entries into the notebook will contain a variety of information. At the beginning of each entry, the date, start time, weather, all field personnel present, level of personal protection being used onsite, and the signature of the person making the entry will be entered. The names of visitors to the site, all field sampling team personnel and the purpose of their visit will be recorded in the field notebook.

All measurements made and samples collected will be recorded. All entries will be made in indelible ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Wherever a sample is collected or a measurement is made, a detailed description of the location of the station will be recorded. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the procedures documented in this plan. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample is collected, volume and number of containers into which the sample is placed in the field. Sample numbers will be assigned prior to going onsite. Significant field notebook entries (samples collected, significant observations) shall be countersigned by another member of the project team.

4.2 Sample Numbering System

A sample numbering system will be used to identify each sample taken during this program. This numbering system will provide a tracking procedure to allow retrieval of information about a particular sample and assure that each sample is uniquely numbered. For this project, a two letter designation will be used to identify the site where the sample is collected. The baseline monitoring program will be designated by AR. Sample numbers will be synonymous with well numbers. For instance, for Well No. 104A, the Sample Number will be AR-104A.

Sample depths will be recorded in the field notes or on the boring logs. Duplicates and field blanks will be prepared and numbered uniquely as if they were separate samples. A record of identification numbers for samples, blanks, and splits will be maintained and given to the laboratory and sampling QA Director for analytical data review of field precision and accuracy.

4.3 Labeling and Recordkeeping

Following collection of samples, each member of the field team must sign chain-of-custody form as samplers. Likewise, whoever packages the samples for shipment should sign, date, and indicate the time under "relinquished by." The date and time of sample at each location should be entered along with the number of sample bottles filled, the analyses required, and whether the sample was a composite or grab. Any compositing done in the analytical laboratory will necessitate the initiation of a new custody form as a "new" sample is created from the field samples.

During sample collection at each location, permanently bound field logs will be used to record all field measurements and other pertinent information. This information will include date, sampling location, time, ambient temperature, barometric pressure, and sample identification number. Each sample container will be affixed with a label (and tag) which includes all of this sample identification information. Indelible ink will be used for all labeling.

Under the Remarks Section, the Donohue custody seal numbers used to seal the shipping cooler should be entered.

4.4 Chain-of-Custody

Prior to delivery of the samples to the laboratory, a chain of custody form will be prepared. This form will include sample identification numbers, date and time of sample collection, number of samples being submitted to the laboratory, and the signature of field personnel collecting the samples. Chain of custody forms will be completed in duplicate. The original custody form will be taped to the inside lid of the shipping cooler and the duplicate will be maintained for the project files. The shipping cooler will be secured with strapping tape and custody seals will be placed across the cooler opening to ensure sample integrity during shipment.

The information on the custody form (date, time, sampler(s), analyses) will match the information on the adhesive label. Group and number bottles sequentially (when multiple bottles are present for a particular sample (i.e., 1 of 2, 2 of 2)). It is important to use only indelible waterproof ink on labels and tags. "Magic" markers will not be used on or near volatile vial labels, tags, and bottles to avoid contamination. Sample labels will be covered with 3 inch wide clear adhesive tape to help eliminate label soak-off.

5.0 ANALYTICAL PARAMETERS

5.1 Organic Analytes

During the baseline monitoring program, field samples will be analyzed for those organic constituents given in Table 3.

5.2 Field Parameters and Inorganic Analytes

Groundwater samples will be analyzed for the field parameters and organic analytes as shown in Table 1 and 4.

6.0 FIELD SAMPLING ORGANIZATION/SCHEDULE

Individuals responsible for field activities which include the development of monitoring wells, and the sampling for chemical analysis of the groundwater are given below:

PROJECT MANAGER:	Dave Voight
SITE GEOLOGIST/HYDROGEOLOGIST:	Joel Giraud Mark Powers
GROUNDWATER SAMPLING:	Kurt Rubsam Mike Billman
SITE HEALTH AND SAFETY OFFICER:	Joel Giraud Mark Powers
LAB AND SAMPLING QC DIRECTOR:	Marcia Kuehl
DRILLING CONTRACTOR:	Twin City Testing

7.0 WELL INSTALLATION, DEVELOPMENT, IN SITU PERMEABILITY AND RESPONSIBILITY

7.1 Monitoring Well Installation and Development Procedures

7.1.1 General Requirements

Donohue will provide a qualified geologist or geotechnical engineer who shall be onsite for all drilling activities including well installation, development, and other related operations. Drilling activities will include the installation of two well nests on the northwestern portion of this property (Figure 1). Each nest will consist of one 20-foot observation well and one 45-foot piezometer.

The selected drilling subcontractor shall accomplish installation of the monitoring wells with a water-rotary capable drill rig. The subcontractor shall use dry, hollow stem or solid auger methods while in overburden. No water may be used during soil

boring. "NX" (or larger) diamond-core drilling methods should be used to penetrate and retrieve samples of bedrock or boulders, if encountered.

Soil and/or rock samples for documentation of soil types shall be taken at 5-foot depth increments in intermediate piezometers. Samples will be obtained only at the screened interval in observation wells. Selected samples will undergo geotechnical testing.

7.1.2 Decontamination of Equipment and Materials

Prior to mobilization onsite, the drilling subcontractor shall steam clean the drill rig and associated equipment used during soil boring, rock drilling, and well installation.

7.1.3 Condition of Drill Rig and Equipment

Equipment utilized during this program shall be maintained to ensure that contamination does not result during drilling activities. Leaking seals or leaking tanks containing fluid other than clean water shall not be permitted.

7.1.4 Procedures to be Used for Cleaning Equipment

- ° Remove all drill rod, augers, samples, and other equipment except that in the tool boxes of the rig which will not be utilized in the operations.
- ° Steam-clean the drill rig utilizing potable water. The water supply source used is to be documented.
- ° Lay drill rod, augers, casing, samplers, pipe wrenches, etc., on hoses or other supports and steam clean until all visible signs of grease, oil, mud, etc., are removed. Use brushes as required.
- ° Do not use greasy or muddy gloves when handling tools after cleaning.
- ° Avoid using freshly-painted bits and tools which will leave paint chips at the sampling site.
- ° Clean water tanks, pumps, mud pans, hoses, including hoses and tanks used to transfer water from source to drill rig tank, i.e., pickup truck water tanks.

7.1.5 Decontamination of Materials

- ° Use only new materials for well construction. Only bagged cement, powdered bentonite, bentonite pellets in containers, new well screen, riser pipe, and well protectors

shall be used. Steel casing which is rusty but not previously in contact with hazardous materials may be utilized provided it has been decontaminated prior to use.

- ° Use stainless steel (Schedule 304) pipe for riser and well screen. Oil shall not be used during the factory threading operations.
- ° Workers shall use clean gloves when handling riser and well screen.
- ° Sand and/or gravel filter pack material is to be clean and uncontaminated. Record the manufacturer, type, size, and source of the filter pack material.
- ° Steam clean the well protector and any casing pipe.
- ° Potable water used in drilling and grouting operations shall be obtained from a source deemed "safe" and uncontaminated by Donohue prior to use.

7.1.6 Decontamination of Well Development Tools

- ° All pumps used in well development shall be rinsed in acetone, soaked in water from the designated source, and steam cleaned. Pumps which leak or otherwise may cause contamination will be rejected. Electrical tape shall not be used to band wires to the discharge pipe of submersible pumps. Bands shall be stainless steel or plastic without glue.
- ° Only stainless steel or teflon bailers shall be utilized. Bailers including the line shall be cleaned immediately before use. Dirty line shall be rejected. A plastic sheet shall be laid on the ground to hold the bailer line or a decontaminated reel employed.
- ° Only compressors equipped with operable oil traps and a filter shall be utilized. The oil trap and filter shall be of a design approved by Donohue.

7.1.7 Protection of Water-Bearing Strata

It is expressly understood that toxic and/or contaminating substances shall not be used at any time during the monitoring well installation process. All field activities and methods shall be sufficient to positively prohibit the introduction of contaminants from one water bearing stratum to another via the well bore.

- ° The use of drilling fluids (i.e., bentonite, Quickjel, barite, revert, etc.) which contain contaminating additives is not permitted.

- ° Grease or oil on drill rod joints is not permitted.
- ° Dispersing agents such as phosphates or acids shall not be used in well installation or development.
- ° No attempt shall be made to chemically disinfect the well.

7.1.8 Drilling and Installation of Groundwater Monitoring Wells

The drilling subcontractor shall install four groundwater monitoring wells at the project site. Well locations are discussed in the previous section.

The design and construction of monitoring wells shall follow as closely as practical the design for properly installed, low-yield domestic water supply wells. Recommended practices for the construction of such wells are set forth in "Manual of Water Well Construction Practices", USEPA Publication No. EPA 570/9-75-001. Additional design recommendations are given in "Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities," USEPA Publication No. EPA 530/SW-611. Any state or local certification requirements and codes for construction followed shall be met. The selected drilling firm shall be responsible for obtaining any well drilling permits required by state or local authorities and for complying with state or local regulations concerning submission of well logs and samples.

Drilling will be accomplished with a minimum 4-1/4 inch I.D. (8-7/8" O.D.) hollow stem auger.

Each soil boring in which an observation well will be installed shall be advanced to a 20-foot depth or until the water table is encountered and at least 10 feet of screen can be installed. The observation well shall yield representative samples of the groundwater that can be used for chemical analysis. It shall be constructed so that the upper surface of the water table is encountered by the well screen and the presence or absence of any nonaqueous phase on top of the water table can be determined, and sampled if present.

Each intermediate piezometer boring shall be advanced to a depth of 45 feet, or to a depth where the top of the well screen in the piezometer lies 20 feet below the bottom of the screen in the piezometer. Each piezometer shall yield representative samples of the groundwater that can be used for chemical analysis.

Well design details will be documented on a field form such as that given in Appendix B.

7.1.9 Soil Sampling

Soil sampling using a standard 2-inch split spoon sampler will occur at 5-foot depth increments in each piezometer. Soil samples will only be obtained at the screened interval in observation wells. Selected samples will undergo geotechnical testing.

7.1.10 Rock Sampling

Bedrock (or boulders) encountered during this drilling program shall be cored using standard diamond core drilling methods (ASTM D2113-83). The core shall be "NX" size or larger.

Only clean, nonchlorinated water or formation water from the well being drilled may be used as a drilling fluid for coring. A sample of the water shall be retained by Donohue's onsite geologist or representative.

All rock core recovered shall be logged by the geologist, photographed with 35 mm color slides, and stored in wooden core boxes. The cores shall be stored by the drilling subcontractor until the project is completed.

7.1.11 Soil Boring and Well Construction Documentation

Well construction diagrams detailing well construction materials and methods shall be prepared by the drilling subcontractor for inclusion in the engineering report. In addition, final boring logs shall be included in the final report. The logs shall be prepared by the drilling subcontractor and submitted to Donohue no later than 30 days after the well is completed. Information provided in the logs shall include (at a minimum):

- ° Reference elevation for all depth measurements.
- ° Depth of each change of stratum.
- ° Thickness of each stratum.
- ° Identification of the material of which each stratum is composed according to the Unified Soil Classification System (or standard rock nomenclature).
- ° Depth interval from which each formation sample was taken.
- ° Depth at which hole diameter (bit sizes) change.
- ° Depth at which groundwater is first encountered.
- ° Depth to the static water level and changes in static water level with well depth.

- ° Total depth of completed well.
- ° Depth or location of any loss of drill water circulation, loss of tools or equipment.
- ° Location of any fractures, joints, faults, cavities, or weathered zones.
- ° Thickness and depth of grouting seals.
- ° Nominal hole diameter.
- ° Volume of cement and bentonite used during grouting and for well seals.
- ° Depth and type of well casing.
- ° Length, diameter, slot size, material, and manufacturer of well screen(s), and measured depth to top/bottom of well screen.
- ° Any sealing-off of water-bearing strata.
- ° Static water level upon completion of drilling, 24 hours following well construction, and after development.
- ° Start and completion dates for soil boring and well construction.
- ° Other construction details pertaining to monitoring well installation. This includes documenting the type and source of gravel/sand filter pack material, seal materials, concrete, etc.

7.1.12 Concrete Pad and Collar

The Consultant shall be responsible for installing a concrete collar/pad at each monitoring well location.

- ° A minimum 5-foot thick concrete collar shall be installed at each well. Actual construction will be dependent on whether the well extends above the ground surface or is installed flush with the ground surface.
- ° The concrete shall be air-entrained.
- ° The concrete collar shall have a minimum thickness of five feet. Collar thickness shall be determined by the Engineer based on specific site needs and/or the depth to frost. Protective metal casing will be imbedded into the concrete pad/collar to protect the well riser.

- ° Details of the construction of the concrete pad and collar shall be recorded on the monitoring well diagram.

In addition, each well shall have a lockable vented cap which will prevent the the entrance of foreign material into the completed well.

7.1.13 Well Protector Pipe

The drilling subcontractor shall be responsible for protecting monitoring wells following those procedures given below.

Wells Extending Above Ground Surface

- ° The stainless well riser ("stick-up") shall be enclosed within 4-inch diameter (minimum), Schedule 40 steel casing, with hinged, locking top.
- ° The top of the protective steel casing shall be 24 inches to 36 inches above ground level, and set into the concrete collar to a depth of at least three (3) feet.
- ° The steel protector pipe shall be covered with an overlapping locking steel cap. All locks shall be keyed alike. The inner casing must be capped with an overlapping threaded cap. The protector pipe shall be vented by a 1/2-inch diameter drain hole placed just above the concrete cap.
- ° All protector pipes shall be free of rust, dirt, grease, etc., and painted a bright color (i.e., red, yellow, orange).
- ° If a monitoring well is damaged, the damage must be corrected within 72 hours of its discovery. If a monitoring well is damaged irreparably, it must be properly sealed and abandoned in accordance with State guidelines, and within seven (7) days of discovery of the damage.

Wells Mounted Flush With Ground Surface

- ° The stainless well riser shall be enclosed within 4-inch diameter (minimum), Schedule 40 steel casing, with hinged, locking top.
- ° The top of the protective steel casing shall be 6 inches below the ground surface, and set into the concrete collar to a depth of at least three (3) feet.
- ° A flush-mount well protector top will be installed by excavating soil within an 18-inch radius from the well riser, to a minimum depth of 12 inches. Set steel collar, with locking well cap in concrete as appropriate.

7.1.14 Well and Monument Locations

Coordinates and elevations shall be established for each monitoring well. The coordinates shall be to the closest 1.0 foot and referenced to the State Plane Coordinate System. If the State Plane Coordinate System is not readily available, an existing local grid system shall be used.

Elevation of the ground surface for the top of the casing to the closest 0.01 foot shall be obtained at each well. Elevations shall be referenced to the National Geodetic Vertical Datum of 1929. If the 1929 Datum is not readily available, the existing local vertical datum shall be used.

One permanent control monument shall be placed in an accessible location within the limits of the work. Coordinates and elevations shall be established to the closest 0.01 foot for each monument. The location, identification, coordinates and elevations of the wells and monuments shall be plotted on maps with a scale large enough to show their location with reference to other structures at the individual sites.

A tabulated list of the monitoring wells and monument, copies of all field books, and all computation sheets shall be prepared and submitted to Donohue. The tabulation shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations. These items shall be submitted to Donohue in the final report.

7.1.15 Identification of Wells

The drilling subcontractor shall affix a permanent marking or tag to the outer steel protective casing of each well which clearly identifies the well number.

7.1.16 Well Plumbness and Alignment

All risers shall be set round, plumb, and true to line. Well alignment may be determined by inserting a 10-foot long section of pipe, 1/2-inch less in diameter than the inner diameter of the well riser pipe.

7.2 Well Development

The drilling subcontractor will initiate well development after all wells have been constructed, but no sooner than 48 hours after grouting is completed. Each well shall be developed by pumping and/or surging, without the use of acids, dispersing agents or explosives. Development will be accomplished with a Kech pump and/or bailer, possibly supplemented with a surge block.

Development shall continue until, at a minimum, a volume equaling five times the standing water volume in the well has been removed. The standing water volume includes the water volume within the well screen and casing, plus the saturated annulus. Should the water remain discolored after development, the volume of water removed should be increased to ten times the well volume. If the water still remains discolored, note this on the well development form and notify the Engineer. No water or other liquid may be introduced into the well other than formation water from that well. Representative formation water shall be assumed to have been obtained when the pH, temperature, and conductivity readings are stable (within 10 percent), the water is clean, and the minimum volumes for development specified herein have been completed. Record all information on the appropriate form (Appendix C) to include:

1. Well number.
2. Dates and time of well development.
3. Static water level, depth to the bottom of the well before and after development, the type and size of the pump, and/or bailer used.
4. Description of surge technique, if used.
5. The volume of water removed prior to each description of the removed water.
6. The physical characteristics of the removed water to include clarity, color, odor, conductivity, pH, temperature, and physical description of removed sediments to include lithology and grain size. At a minimum, these measurements shall be taken at the start, during, and at the conclusion of the development.

7.3 Well Construction Materials

7.3.1 General

This section discusses the composition of well construction materials and their placement to be used during this program. This includes the well screen, riser pipe, joining risers, gravel/sand filter packs, bentonite seals, water, and bentonite/sand grout. All materials used in construction shall be free of chemicals, paint, coatings, etc. that could result in contamination of the groundwater. All materials shall be decontaminated in accordance with the sections that discuss soil and water contamination procedures.

7.3.2 Well Screen

Continuous wire-wound screen shall be used. Screen lengths shall vary from 10 feet in length for observation wells to five feet in length for intermediate piezometers.

Screens will have a minimum 2-inch inside diameter. Slot size shall be 0.010-inch (No. 10 slot) in all wells. The screen used shall be compatible with aquifer and gravel/sand pack material, so that the aquifer can be properly developed to produce sediment-free water.

7.3.3 Screen Location

The Donohue representative shall have the responsibility of placing the well screen so that the completed monitoring well functions satisfactorily. Screens in the intermediate piezometers will be installed so that the top of the screen lies at a minimum 20 feet below the bottom of screen in the observation well.

7.3.4 Riser Pipe

All well riser pipe shall consist of new, threaded, flush-joint, stainless steel pipe with a minimum 2-inch inside diameter. All well risers shall, as a minimum, conform to the requirements of Schedule 304 pipe and shall bear markings that will identify the material as such.

7.3.5 Joining Riser

Riser sections shall be joined by threaded, flush-joint couplings, to form watertight unions.

- ° All joints shall be teflon taped.
- ° No lead shot or lead wool is to be employed in producing seals at any point in the well.

7.3.6 Gravel/Sand Filter Pack

Gravel/sand filter pack placed in the annular space around the well screen shall meet the following criteria:

- ° The filter pack shall be uniformly sized, well sorted, washed quartz silica sand.
- ° The actual grading of filter pack material shall be compatible with the aquifer and screen slot size (No. 30).
- ° The filter pack shall extend a minimum of 2 feet above the well screen in observation wells, provided that a minimum 2-foot bentonite seal can be installed.

7.3.7 Bentonite Pellet Seal

A minimum 2-foot bentonite seal, consisting of tamped bentonite pellets, shall be placed into the annular space between the riser and boring wall and above the gravel/sand filter pack. This may require the use of a tremie pipe to preclude the possibility of bridging within the annulus.

- ° Bentonite pellet seals shall be fully hydrated before being placed into the annular space. If determined necessary by the Engineer, time for a seal hydration will be determined by placing bentonite pellets in a container having a perforated bottom. Water will be poured over the bentonite pellets until they are fully hydrated. Minimum seal hydration shall be one-half hour.
- ° No grout will be introduced into the annular space of the boreholes until the bentonite seal is fully hydrated. Time of hydration and other well construction details will be recorded for each well.
- ° A half-foot layer of filter pack sand shall be placed on the hydrated cover seal to stabilize the seal for grouting.

7.3.8 Grouting Procedure and Grouting Mixture

- ° The grout shall consist of pure bentonite, fine to medium sand (20-30% of total solids, by weight), and water mixed until a viscosity of 70 seconds per quart (Marsh Funnel Viscosity test) is attained. Approximately 40 gallons of clean water are to be used with every 100 pounds of bentonite and 20-30 pounds of sand.
- ° The grout shall be tremied in place. The rate of injection shall be contained so as to avoid jetting action and the displacement of the bentonite pellet seal. A side discharge tremic pipe shall be used.
- ° The grout shall be placed to within six to seven feet of the surface.
- ° The level at which the grout is to be placed is dependent on thickness of the concrete collar.

7.3.9 Granular Bentonite Seal

An upper bentonite seal consisting of granular bentonite will be installed above the grout in each piezometer. The seal shall be a minimum two (2) feet thick when fully hydrated. This seal separates grout from the cement collar and minimizes the possibility of surface water infiltrating into the well annulus.

8.0 WELL ABANDONMENT

Well abandonment, if necessary, will require pulling the well screen and riser, and then backfilling with a cement-bentonite slurry.

9.0 REFERENCE STANDARDS

1. American Society for Testing and Materials (ASTM):

- a. ASTM C150-83A - Specification for Portland Cement.
- b. ASTM D421-85 - Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
- c. ASTM D422-63 - Particle-Size Analysis of Soils.
- d. ASTM D1586-67 - Method of Penetration Test and Split Barrel Sampling of soils.
- e. ASTM D1587-83 - Method for Thin-Walled Tube Sampling of Soils.
- f. ASTM D1785-83 - Standard Specifications for Poly (Vinyl Chloride)(PVC) Plastic Pipe, Schedule 40, 80, and 12.
- g. ASTM D2113-83 - Method for Diamond Core Drilling for Site Investigation.
- h. ASTM D2216-80 - Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixture.
- i. ASTM D2487-83 - Classification of Soils for Engineering Purposes.
- j. ASTM D2488-69 - Recommended Practice for Description of Soils (Visual - Manual Procedure).
- k. ASTM D4318-84 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

RP/MILWUTA/AA3

APPENDIX A
WELL PURGING AND SAMPLE COLLECTION LOGS

Well Purging and Sample Collection

Pump _____ Manufacturer _____ Diameter _____ Description of site _____
(weather, temp, soil, conditions)

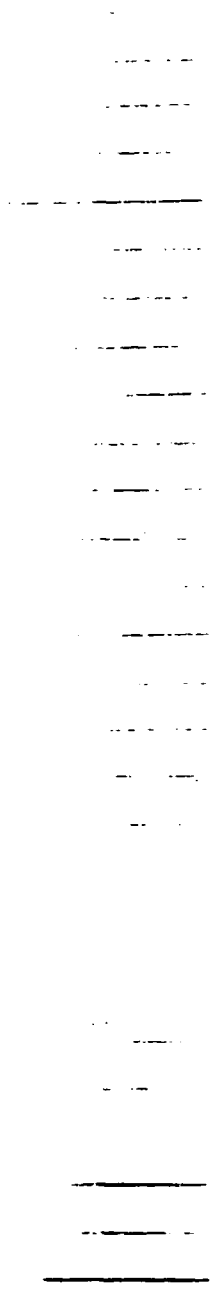
[illegible]

Notes

Signature _____ Date _____

P.M. 186

APPENDIX B
WELL CONSTRUCTION DIAGRAM

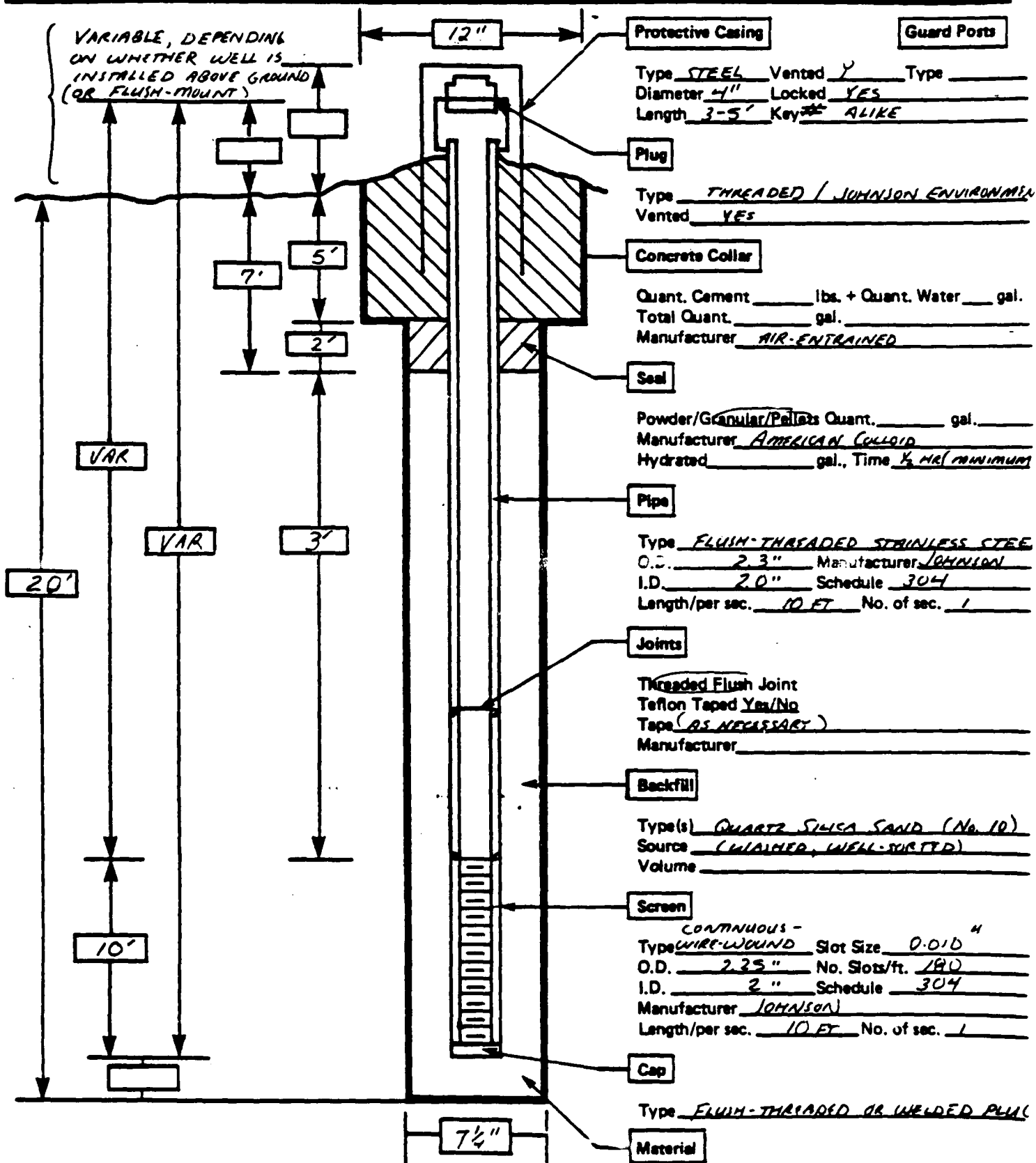


Donohue

Sheet ___ of ___

OBSERVATION WELL INSTALLATION DIAGRAM

Well No. _____

Site: USARC TRAINING AREA Date: NOVEMBER 1988By: D. VOIGHT Project No. 15977.007

Donohue**PIEZOMETER INSTALLATION DIAGRAM**Well No. Site: USARV TRAINING AREADate: NOVEMBER 1981By: D. VALLEYProject No. 15977-007

VARIABLE, DEPENDING ON WHETHER WELL IS INSTALLED ABOVE GROUND SURFACE (OR FLUSH-MOUNT). SEE SPECIFICATIONS.

Protective Casing
Type STEEL Vented Y No.
Diameter 4" Locked YES Type
Length 3-5' Key ALKE

Guard Posts

Plug
Type THREADED Vented YES

Concrete Collar
Manufacturer AIR-ENTRAINED
Cement lbs. + Water gal.
Total Quantity gal.

Seal
Manufacturer AMERICAN COLLOID
Powder/Granular/Pellets Quant. gal.
Hydrated gal., Time 1/2 HR MINIMUM

Pipe
Type FLUSH-THREADED Schedule 304 STAINL
O.D. 2.25" Manufacturer JOHN S&S
I.D. 2.0"
Length per sec. 10.8 No. of sec.

SAND-Bentonite Grout BENTONITE POWDER
Mix 20-30% SD Cement Bentonite
Cement lbs. + Bentonite lbs. + Water gals.
Total Quantity gals.
Manufacturers MARSH FUNNEL VISCOSITY 70 sec/100

Joints
Threaded Flush FLUSH-THREADED
Teflon Taped Yes/No
Manufacturer

Seal
Powder/Pellets Quant. gals.
Hydrated gal., Time 1/2 HR MINIMUM

Screen CONTINUOUS
Type WIRE-WOUND Slot Size 0.010"
O.D. 2.25" No. Slots/ft. 180
I.D. 2.0" Schedule 304
Length per sec. 5 No. of sec. 1
Manufacturer JOHN S&S ENVIRONMENTAL

Backfill
Type WASHED, WELL-SORTED QUARTZ
Source SILICA SAND (No 10 MIN)
Volume gal.

Cap
Type FLUSH-THREADED OR WELDED
Volumes

Material

Notes: Water Source

APPENDIX C
WELL DEVELOPMENT FORM

Donohue

Well Development

Engineers & Architects

Project No. _____ Site _____

Method of Development Pumped _____ Bailed _____ Blown _____ Surge Block _____

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ **Manufacturer** _____ **Diameter** _____

Description of site (weather, temp, soil conditions) _____

[illegible]

Additional Notes: _____

Entered on computer _____ Signature _____ Date ____/____/____

HEALTH AND SAFETY PLAN
USARC TRAINING GROUNDS
84TH DIVISION
MONITORING WELL INSTALLATIONS
GROUNDWATER SAMPLING

November, 1988

Donohue & Associates, INC.
4738 North 40th Street
Sheboygan, WI 53083

Project No. 15977.007

1.0 INTRODUCTION

This Health & Safety Plan describes the procedures to protect Donohue personnel who are involved in field investigation activities at the USARC Training Area, 84th Division.

This plan establishes field procedures for:

- ° Atmospheric monitoring techniques
- ° Personal protective clothing and equipment
- ° Emergency response actions
- ° Overall health and safety program elements

All personnel involved in the site investigations are required to familiarize themselves with, and conform to, the provisions of this Health and Safety Plan (HASP). Subcontractors are required to provide their own HASP which in content shall be equal to or more stringent than the following HASP. Subcontractors shall supply the necessary safety equipment, training, and other health and safety program elements to their personnel which are presented within this plan. The safety of all on-site personnel is ultimately the responsibility of the respective employers.

All subcontractors upon request will submit to Donohue for informational purposes and for the project files, a copy of their company Health and Safety Program. Donohue cannot, however, be responsible for enforcing the health and safety of site workers other than their own employees.

2.0 HAZARD EVALUATION

Groundwater analysis has shown the presence of four compounds near the area where drilling operations will occur. Table 1 lists the concentrations found for each chemical and the 8 hour permissible exposure limit for each chemical as recommended by the Occupational Safety and Health Administration (OSHA). Of these four chemicals, vinyl chloride will cause the greatest concern both because of its higher concentration and because of its low permissible exposure limit. A more detailed explanation of the hazards involved with each chemical is provided in Appendix A.

3.0 PROJECT ACTIVITIES

Field activities at the USARC site involve the installation of four groundwater monitoring wells, soil sample collection during construction of the monitoring well borings, groundwater sampling, and water level measurements. Health and safety protocols will be implemented during each of these activities.

TABLE 1 .

Summary list of chemicals present in the Groundwater,
Their concentrations, and their permissible exposure limits

USARC Training Area
84th Division

<u>Name</u>	<u>Concentration (ppb)</u>	<u>Permissible Exposure Limit (ppb)</u>
Vinyl Chloride	12.5 - 336	1,000
1,2-Dichloroethylene	4 - 24	200,000
1,1-Dichloroethylene	1	5,000
Trichloroethylene (TCE)	0.2	100,000

TR/MISC/LK8

4.0 SAFETY PROCEDURES ASSOCIATED WITH THE DRILLING AND SAMPLING OF SOIL BORINGS, AND THE INSTALLATION OF MONITORING WELLS

4.1 Level of Protection

Because organic chemicals are present in the groundwater, the potential exists for site personnel to become exposed to these substances. The primary concern is for skin contact with soil and water containing these contaminants and the inhalation of organic vapors generated from the soil cuttings and/or water.

Drilling and soil sampling activities will be conducted in Level D personal protective clothing and equipment with the option to upgrade to Level B protection if the need arises.

The use of Level D protection will be used to minimize contact of unprotected body surfaces with contaminants that may be encountered. Level D protective clothing and equipment include the following:

- Hardhat
- Safety glasses or goggles
- Steel toe, steel shank Neoprene boots
- Nitrile gloves
- Disposable latex surgical gloves (to be worn when sampling)
- Disposable protective tyvek coveralls (optional unless upgrade is required)

Level B personal protection includes the above clothing and equipment, but also includes either the self contained breathing apparatus (SCBA) or supplied air.

Donohue's Corporate Health and Safety Manager must be consulted prior to the initiation of Level B. If Level B is required, personnel involved with this task of the project will have appropriate health and safety training for Level B protection.

4.2 Monitoring

It will be necessary to monitor the atmospheric conditions during the drilling and sampling activities. An HNU photoionization detector calibrated to vinyl chloride will determine the need to continue operations in Level D or to upgrade protection to Level B. The atmosphere in the immediate work area (i.e. waist level) and in the bore hole will be monitored. Concentrations reading above 1 ppm (continuous for 5 minutes) in the breathing zone will constitute the need to upgrade to Level B. In this situation field activities will be halted and the Corporate Health & Safety Manager will be consulted prior to any upgrade. Drager tubes may be used to identify the compounds. Information gained from the drager tubes will be used when evaluating the need to upgrade.

An oxygen/combustible gas detector will be used to monitor the atmosphere for oxygen content and the presence of combustible gases during drilling activities. If a reading of less than 19.5 percent by volume of oxygen in air is measured and/or the combustible gas detector indicates a reading above 20 percent of the lower explosive limit (LEL), then field activities will be halted until the atmosphere clears.

5.0 SAFETY PROCEDURES ASSOCIATED WITH TAKING WATER LEVEL MEASUREMENTS AND SAMPLING MONITORING WELLS

5.1 Level of Protection

The use of Level D protection will be used to minimize contact of unprotected body surfaces with contaminants that may be encountered. Level D protective clothing and equipment includes the following:

- ° Safety glasses or goggles
- ° Disposable latex surgical gloves
- ° Nitrile gloves (optional)
- ° Disposable protective tyvek or saranex coveralls.

5.2 Monitoring

No atmospheric monitoring will be necessary. Unless previous HNU readings observed during well installation indicate exceeded action levels.

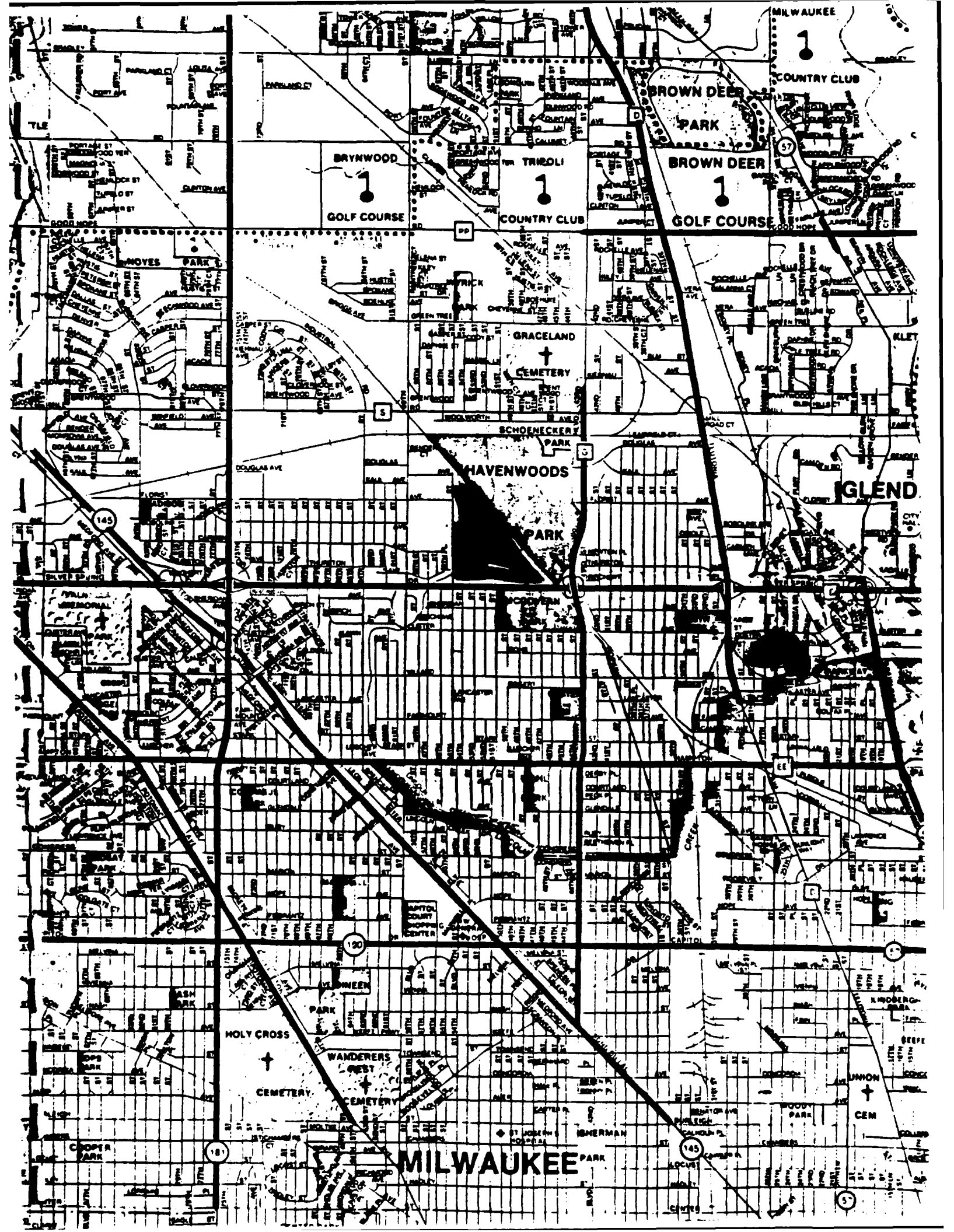
6.0 DECONTAMINATION

Since most contaminants suspected to exist are in low to moderate concentrations on the site, decontamination of equipment and boots with mild detergent followed by rinsing with water should be sufficient. Water from the decontamination procedures will be discharged on the site surface. Disposable articles will be placed in sealed plastic bags and disposed with non-hazardous materials.

7.0 EMERGENCY RESPONSE

A field first aid kit will be made available on the site at all times. Fire extinguishers will be located in the immediate work vicinity in the event of a fire. Subcontractors will be required to provide a fire extinguisher for type A, B, and C fires on each drill rig. A portable eyewash station will be located in the immediate work vicinity.

A map to the nearest hospital is included with this health and safety plan. A copy of this map should be kept near the immediate work vicinity. Important emergency response information and telephone numbers are as follows:



Hospital Name - St. Michael Hospital
Hospital Address - 2400 West Villard Avenue
Hospital Emergency telephone number - 527-8175
Hospital telephone number - 527-8000
Ambulance telephone number - 264-2355
Fire - 347-2323

GENERAL SAFETY PROTOCOLS

- ° No smoking, eating, or drinking, except in designated "clean" areas of the project site.
- ° Use personal protective clothing and equipment that is required and as instructed.
- ° Maintain all safety equipment in good working and clean condition. Calibrate the monitoring equipment daily.
- ° Take appropriate steps to correct unsafe conditions as soon as possible.
- ° All personnel who comply with this project SSSP are required to sign the attached safety acceptance sheet and submit it to the SSO or the HSM.
- ° In the event that atmospheric monitoring indicates the presence of possible contaminants, halt work activities and notify the Donohue Health and Safety Manager immediately before proceeding.

A site-specific safety form is attached with emergency response information (i.e. nearest hospital, phone number, fire, police, ambulance, etc).

TR/MISC/LK7

ACCEPTANCE OF TASK SPECIFIC SAFETY PLAN
DRILLING, SOIL AND SAMPLING ACTIVITIES

I, the undersigned, having read and understood the task-specific safety plan, will abide by and follow all safety protocol set forth in the plan.

USARC Training Grounds - Milwaukee
Project Site

Signature

Donohue & Associates, Inc.
Company Represented

Date

TEAR THIS PAGE OUT AND SUBMIT TO PAM MARKELZ, HEALTH AND SAFETY
MANAGER, DONOHUE & ASSOCIATES, INC.

APPENDIX A

**HAZARD LINES FOR CHEMICALS PRESENT IN
THE GROUNDWATER AT THE USARC TRAINING AREA,
84TH DIVISION**

AN ACCESSION NUMBER: 2772, 8805.

IN CHEMICAL NAME: **VINYL CHLORIDE**

SY SYNONYMS: CHLOROETHYLENE, CHLOROETHENE, MONOCHLOROETHYLENE, VC,
VCM, VINYL CHLORIDE MONOMER, UN 1086, ETHYLENE, CHLORO-, CHLOROETHENE,
CHLOROETHYLENE, ETHYLENE MONOCHLORIDE, MONOCHLOROETHENE, TROVIDUR,
VINYL C MONOMER, ETHENE, CHLORO-.

RN CAS NUMBER: 75-01-4.

REG. TOXIC NUMBER: RD9625000.

CHEMICAL FORMULA: C₂H₃CL.

PD

PHYSICAL DESCRIPTION:

COLORLESS GAS; EASILY LIQUIFIED:

ETHEREAL ODOR.

MOL WT:	62.5
BOILING PT:	8 F
SOLUBILITY:	NEGLIGIBLE
FLASH PT:	-108 F
VAPOR PRES:	3.31 ATM @ 21.1 C
MELT PT:	-245 F
UEL IN AIR:	33%
LEL IN AIR:	3.6%
HEC IN AIR:	882 F
SPEC GRAVITY:	0.9100
VAPOR DENSITY:	2.24
ODOR THRESHOLD:	
OCTANOL/WATER CO-EFFICIENT:	

EL

PERMISSABLE EXPOSURE:

1 PPM OSHA TWA - 5 PPM OSHA 15 MINUTE CEILING

NIOSH RECOMMENDED EXPOSURE - LOWEST DETECTABLE LIMIT

5 PPM ACGIH TWA

CANCER SUSPECT AGENT (OSHA 29CFR1910.1017)

HUMAN CARCINOGEN (ACGIH, IARC, NTP)

ANIMAL CARCINOGEN (IARC)

TERATOGENIC DATA (RTEC)

MUTAGENIC DATA (RTEC)

AQUATIC TOXICITY RATING 0 (TLM96 >1000 PPM)

TLM96 - BLUEGILL 1220 PPM, LARGEMOUTH BASS 1060 PPM

CERCLA HAZARD RATINGS - TOXICITY 2 - IGNITABILITY 3 - REACTIVITY 1 -
PERSISTENCE 1

TOXICOLOGY: VINYL CHLORIDE IS A HUMAN CARCINOGEN. IT IS CARCINOGENIC
TO THE LIVER, BRAIN, LUNG, BLOOD, AND LYMPHATIC SYSTEM. SYSTEMIC
EFFECTS

INCLUDE LIVER AND KIDNEY DAMAGE AND CENTRAL NERVOUS SYSTEM DISORDERS.
VINYL CHLORIDE ALSO CAUSES RAYNAUD'S PHENOMENON AND ACROOSTEOLYSIS.

CONCENTRATIONS ABOVE 1000 PPM CAUSES DROWSINESS, BLURRED VISION, STAG-
GERING, AND TINGLING AND NUMBNESS IN THE FEET AND HANDS.

LIQUID CONTACT CAN CAUSE FROSTBITE AND SEVERE SKIN IRRITATION AND
BURNS. FUMES FROM THE HEATED POLYMER MAY CAUSE PULMONARY SENSITIZATION.
OEL-RAT LD50:500 MG/KG

IHL-GPG LCLO: 20 PPM/30 MIN

OEL-RAT LD50:500 MG/KG

OSHA STANDARD 29CFR1910.1200 HAZARD COMMUNICATION REQUIRES CHEMICAL MANUFACTURERS AND IMPORTERS TO ASSESS THE HAZARDS OF CHEMICALS WHICH THEY PRODUCE OR IMPORT, AND ALL EMPLOYERS HAVING WORKPLACES IN THE MANUFACTURING DIVISION, STANDARD INDUSTRIAL CLASSIFICATION CODES 20 THROUGH 39, TO PROVIDE INFORMATION TO THEIR EMPLOYEES CONCERNING HAZARDOUS CHEMICALS BY MEANS OF HAZARD COMMUNICATION PROGRAM INCLUDING LABELS, MATERIAL SAFETY DATA SHEETS, TRAINING, AND ACCESS TO WRITTEN RECORDS 48FR53250 11/25/83 FOLLOWING OSHA STANDARDS APPLICABLE TO SUBSTANCES LISTED 29CFR1910, OTHERWISE ADVISE.

DANGEROUS EXPOSURE

NONE SPECIFIED

COLORLESS GAS; EASILY LIQUIFIED.

IC

INCOMPATIBILITIES:

STRONG OXIDIZERS. STRONG BASES. ALUMINUM POWDER. COPPER. COPPER ALLOYS. PEROXIDES.

CL

CLOTHING

29CFR1910.1017 VINYL CHLORIDE (H) HAZARDOUS OPERATION (1) EMPLOYEES ENGAGED IN HAZARDOUS OPERATIONS, INCLUDING ENTRY OF VESSELS TO CLEAN POLYVINYL CHLORIDE RESIDUE FROM VESSEL WALLS, SHALL BE PROVIDED AND REQUIRED TO WEAR AND USE, (II) PROTECTIVE GARMENTS TO PREVENT SKIN CONTACT WITH LIQUID VINYL CHLORIDE OR POLYVINYL CHLORIDE RESIDUE FROM VESSEL WALLS. THE PROTECTIVE GARMENTS SHALL BE SELECTED FOR THE OPERATION AND ITS POSSIBLE EXPOSURE CONDITIONS. (2) PROTECTIVE GARMENTS SHALL BE PROVIDED CLEAN AND DRY FOR EACH USE.

-ACGIH "GUIDELINES FOR THE SELECTION OF CHEMICAL PROTECTIVE CLOTHING" INDICATES THE FOLLOWING PROTECTIVE RATINGS FOR MATERIALS COMMONLY USED FOR PROTECTIVE CLOTHING. THESE RATINGS ARE BASED PRIMARILY ON QUANTITATIVE TEST RESULTS AND QUALITATIVE RESISTANCE INFORMATION. (THE RECOMMENDATIONS APPLY TO THE PURE SUBSTANCE ONLY; BREAKTHROUGH-TIME MAY VARY FOR MIXTURES.)

VINYL CHLORIDE: EXCELLENT/GOOD: NONE INDICATED GOOD/FAIR: NITRILE RUBBER CHLORINATED POLYETHYLENE VITON FAIR/GOOD: BUTYL RUBBER POLYVINYL CHLORIDE.

WEAR EYE PROTECTION TO PREVENT:

EMPLOYERS SHALL PROVIDE AND ENSURE THAT EMPLOYEES USE SPLASH-PROOF GOGGLES WHICH COMPLY WITH 29CFR1910.133(A)(2)-(A)(6) WHERE THERE IS ANY POSSIBILITY OF THIS LIQUID CONTACTING THE EYES.

EMPLOYEE SHOULD WASH:

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE SKIN BECOMES CONTAMINATED WITH THIS SUBSTANCE IMMEDIATELY WASH OR SHOWER TO REMOVE ANY CONTAMINANT FROM THE SKIN.

WORK CLOTHING SHOULD BE CHANGED DAILY:

NOT REQUIRED.

REMOVE CLOTHING:

EMPLOYERS SHALL ENSURE THAT NON-IMPERVIOUS CLOTHING WHICH BECOMES CONTAMINATED WITH THIS SUBSTANCE BE REMOVED IMMEDIATELY AND NOT REWORN UNTIL THE SUBSTANCE IS REMOVED FROM THE CLOTHING.

THE FOLLOWING EQUIPMENT SHOULD BE AVAILABLE:

WHERE THERE IS ANY POSSIBILITY OF EXPOSURE OF AN EMPLOYEE'S BODY TO THIS SUBSTANCE, EMPLOYERS SHALL PROVIDE FACILITIES FOR QUICK DRENCHING OF THE BODY WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, EMPLOYERS SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED):

ANY DETECTABLE CONC

- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE
- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE WITH AUXILIARY
- SELF-CONTAINED BREATHING APPARATUS OPERATED IN POSITIVE PRESSURE MODE

ESCAPE

- GAS MASK WITH A CANISTER PROVIDING PROTECTION AGAINST SPECIFIC COMPOUND OF CONCERN (CHIN-STYLE OR FRONTOR BACK-MOUNTED CANISTER)
- APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS

FIREFIGHTING

- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE.

45

MEDICAL SURVEILLANCE:

GENERAL MEDICAL HISTORY.

40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE REQUIRES MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR 30 YEARS 48FR38187 08/22/83 48FR39225 08/30/83 (EFFECTIVE DATE CORRECTION).

RESPIRATORY HISTORY.

PRE-PLACEMENT AND ANNUAL EXAMS.

PHYSICIAN EXAMINATION INDUSTRIAL EXPOSURE HISTORY.

ATTENTION TO SMOKING, ALCOHOL, MEDICATION, AND EXPOSURE TO CARCINOGENS. HISTORY OF HEPATITIS, BLOOD TRANSFUSIONS, HOSPITALIZATION.

BLOOD CHEMISTRY.

COMPLETE BLOOD-COUNT.

CHRONIC RESPIRATORY DISEASE.

LIVER FUNCTION.

ELECTROCARDIOGRAM.

14 BY 17 CHEST P.A. X-RAY.

GGTP.

SGOT.

SGPT.

DIRECT BILIRUBIN.

DIRECT BILIRUBIN.

LDH.

ALKALINE PHOSPHATASE.

GENERAL MEDICAL HISTORY.

ANNUAL EXAMINATION FOR ALL EMPLOYEES WITH TEN YEARS IN LOCATION.

MANDATORY OVER 40 YEARS.

RE

ROUTE OF ENTRY

INHALATION. SKIN ABSORPTION. INGESTION. SKIN OR EYE CONTACT.

TO

TARGET ORGANS:

CENTRAL NERVOUS SYSTEM. KIDNEYS. LIVER. SPLEEN. CARDIOVASCULAR SYSTEM.

SYMPTOMS

STRABISMUS, SIGHT AXES FAIL TO CONVERGE PROPERLY (SC0154).

BRAIN, MASS OF CRANIAL TISSUE (SC0357);

CANCER, MALIGNANT TUMOR OR NEOPLASM (SC0020). FROSTBITE, FREEZING OF TISSUE (SC0068). LIGHTHEADEDNESS, DIZZY (SC0102). NAUSEA, SICKNESS AT THE STOMACH (SC0115). RAYNAUD'S DISEASE, LOWERED BLOOD FLOW TO EXTREMITIES (SC0253). DERMATITIS, INFLAMMATION OF SKIN (SC0044).

KIDNEY DAMAGE, INJURY TO THE KIDNEY (SC0270);

HEPATIC, PERTAINING TO THE LIVER (SC0081);

ANGIOSARCOMA, MIXED SARCOMA AND ANGIOMA (SC0423). REPRODUCTIVE EFFECTS BIRTH DEFECTS (SC0281).

CENTRAL NERVOUS SYSTEM, PERTAINING TO NEURAL BODY SYSTEM (SC0028);

DEPRESSION, DECREASE IN ACTIVITY/FUNCTION (SC0043). CONJUNCTIVITIS, INFLAMMATION OF EYES (SC0031). ANEMIA, RED BLOOD CELLS LESS THAN NORMAL (SC0004). NARCOSIS, STUPOR OR SLEEP DUE TO NARCOTIC (SC0113).

PARESTHESIA, ABNORMAL SENSATION WITHOUT CAUSE (SC0125). WEAKNESS, LACK OF STRENGTH (SC0167).

ABDOMINAL, RELATING TO THE ABDOMEN (SC0001);

PAIN, SUFFERING, EITHER PHYSICAL OR MENTAL (SC0182). DROWSINESS, FALLING ASLEEP (SC0049). ANOREXIA, DIMINISHED APPETITE (SC0006). WEIGHT LOSS, DROP IN BODY WEIGHT (SC0104).

GASTROINTESTINAL, PERTAINING TO STOMACH & INTESTINE (SC0070);

HEMORRHAGE, BLEEDING (SC0080). SWEATING, EXCRETING MOISTURE THROUGH THE SKIN (SC0156).

SENSITIZATION, ALLERGIC REACTION (SC0148);

DERMATITIS, INFLAMMATION OF SKIN (SC0044). LIVER DAMAGE, INJURY TO THE LIVER (SC0221).

LUNG, RESPIRATORY ORGAN (SC0377);

CANCER, MALIGNANT TUMOR OR NEOPLASM (SC0020). ACROOSTEOLYSIS, PLANTAR AND PALMAR ULCERATING LESIONS (SC0187). THROMBOCYTOPENIA, DECREASE IN BLOOD PLATELETS (SC0329).

HEMATOPOIETIC, FORMATION OF BLOOD CELLS (SC0078);

CANCER, MALIGNANT TUMOR OR NEOPLASM (SC0020).

LYMPHATIC, PERTAINING TO LYMPH CELLS (SC0353);

CANCER, MALIGNANT TUMOR OR NEOPLASM (SC0020).

EYE, ORGAN OF SIGHT (SC0170);

IRRITATION, EXTREME REACTION TO A CONDITION (SC0090).

CARDIAC, PERTAINING TO HEART (SC0023);

DAMAGE, PERMANENT INJURY (SC0287). HEADACHE, PAIN IN HEAD OR CRANIUM AREA (SC0075). DIZZINESS, FEELING FAINT, LIGHT-HEADED, UNSTEADY (SC0048). HYPERCALCEMIA, EXCESS BLOOD CALCIUM (SC0464). HEPATOMEGALY, LIVER ENLARGEMENT (SC0465).

FIRST AID

(1 OF 4)

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

(2 OF 4)

IF THIS CHEMICAL GETS ON THE SKIN, IMMEDIATELY WASH CONTAMINATED SKIN WITH SOAP OR MILD DETERGENT & WATER. IF THIS CHEMICAL SOAKS CLOTHING, IMMEDIATELY REMOVE CLOTHING & WASH SKIN WITH SOAP OR MILD DETERGENT & WATER. GET MEDICAL ATTENTION PROMPTLY.

(3 OF 4)

IF A PERSON BREATHES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

(4 OF 4)

IF THIS HALOGENATED HYDROCARBON HAS BEEN SWALLOWED, REMOVE BY GASTRIC LAVAGE OR EMESIS. MAINTAIN BLOOD PRESSURE BY ADMINISTERING 5% GLUCOSE INTRAVENOUSLY. DO NOT GIVE STIMULANTS. GET FURTHER MEDICAL TREATMENT IMMEDIATELY. (DREISBACH - HANDBOOK OF POISONING, 11TH ED.).

SPECIAL DIAGNOSTIC TESTS AND INDEXES OF EXPOSURE:
HAND P.A. X-RAY FOR ACROOSTEOLYSIS.

AN ACCESSION NUMBER: 2940. 8805.

CN CHEMICAL NAME: **1,2-DICHLOROETHYLENE**

SY SYNONYMS: ACETYLENE DICHLORIDE. DIOFORM. ETHYLENE, 1,2-DICHLORO-.
SYM-DICHLOROETHYLENE. NCI-C56031. UN 1150. ETHENE, 1,2-DICHLORO-.
1,2-DICHLOROETHENE.

RN CAS NUMBER: 540-59-0.

REG. TOXIC NUMBER: KV9360000.

CHEMICAL FORMULA: C2H2CL2.

PD

PHYSICAL DESCRIPTION

COLORLESS LIQUID WITH AN ETHER-LIKE SLIGHTLY ACRID ODOR
LIKE CHLOROFORM. IT DECOMPOSES SLOWLY ON EXPOSURE TO AIR, LIGHT, AND
MOISTURE, FORMING HYDROCHLORIC ACID.

MOL WT:	97
BOILING PT:	113-140 F
SOLUBILITY:	0.35-0.63 G
FLASH PT:	43 F
VAPOR PRES:	400 MM @ 87 F
MELT PT:	-56 TO -115 F
UEL IN AIR:	12.8%
LEL IN AIR:	9.7%
MEC IN AIR:	860 F
SPEC GRAVITY:	1.282
VAPOR DENSITY:	3.4
ODOR THRESHOLD:	0.085 PPM
OCTANOL/WATER CO-EFFICIENT:	

EL

PERMISSABLE EXPOSURE

200 PPM OSHA TWA

200 PPM ACGIH TWA

CERCLA HAZARD RATINGS - TOXICITY 2 - IGNITABILITY 3 - REACTIVITY 3 -
PERSISTENCE 1

AQUATIC TOXICITY RATING 1 (TLM96 100 - 1000 PPM)

NO DATA LOCATED - RATED BY THE NATIONAL ACADEMY OF SCIENCES

TOXICOLOGY: 1,2-DICHLOROETHYLENE IS AN EYE IRRITANT AND NARCOTIC.

INHALATION OR INGESTION OF MASSIVE AMOUNTS OF 1,2-DICHLOROETHYLENE
CAUSES CENTRAL NERVOUS SYSTEM DEPRESSION, CHARACTERIZED BY DIZZINESS,
DROWSINESS, AND UNCONSCIOUSNESS.

1,2-DICHLOROETHYLENE IS RECOGNIZED BY ITS SLIGHTLY ACRID ODOR, AND IS
TREATED AS HAVING GOOD WARNING PROPERTIES.

THE THRESHOLD LIMIT VALUE WAS SET AT A LEVEL TO PREVENT NARCOSIS.

ORL-RAT LD50: 770 MG/KG

IPR-MUS LD50: 2000 MG/KG

OSHA STANDARD 29CFR1910.1200 HAZARD COMMUNICATION REQUIRES CHEMICAL
MANUFACTURERS AND IMPORTERS TO ASSESS THE HAZARDS OF CHEMICALS WHICH
THEY PRODUCE OR IMPORT, AND ALL EMPLOYERS HAVING WORKPLACES IN THE
MANUFACTURING DIVISION, STANDARD INDUSTRIAL CLASSIFICATION CODES 20
THROUGH 39, TO PROVIDE INFORMATION TO THEIR EMPLOYEES CONCERNING
HAZARDOUS CHEMICALS BY MEANS OF HAZARD COMMUNICATION PROGRAM INCLUDING
LABELS, MATERIAL SAFETY DATA SHEETS, TRAINING, AND ACCESS TO WRITTEN
RECORDS 48FR53280 11/25/83 FOLLOWING OSHA STANDARDS APPLICABLE TO
SUBSTANCES LISTED 29CFR1910, OTHERWISE ADVISE.

DANGEROUS EXPOSURE

4000 PPM OSHA/NIOSH

COLORLESS LIQUID WITH AN ETHER.

IC

INCOMPATIBILITIES:

STRONG OXIDIZERS. SODIUM.

CL

CLOTHING

FOLLOWING INFORMATION FROM NIOSH/OSHA "OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS":

EMPLOYERS SHALL PROVIDE AND ENSURE THAT EMPLOYEES USE APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT NECESSARY TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE. FACE SHIELDS SHALL COMPLY WITH 29CFR1910.133(A)(2), (A)(4), (A)(5), AND (A)(6).

EMPLOYERS SHALL ENSURE THAT CLOTHING WET WITH THIS SUBSTANCE IS PLACED IN CLOSED CONTAINERS FOR STORAGE UNTIL IT CAN BE DISCARDED OR UNTIL THE EMPLOYER PROVIDES FOR THE REMOVAL OF THE CONTAMINANT FROM THE CLOTHING. IF THE CLOTHING IS TO BE LAUNDERED OR OTHERWISE CLEANED TO REMOVE THE CONTAMINANT, THE EMPLOYER SHALL INFORM THE PERSON PERFORMING THE CLEANING OPERATION OF THE HAZARDOUS PROPERTIES OF THE SUBSTANCE.

-ACGIH "GUIDELINES FOR THE SELECTION OF CHEMICAL PROTECTIVE CLOTHING" INDICATES THE FOLLOWING PROTECTIVE RATINGS FOR MATERIALS COMMONLY USED FOR PROTECTIVE CLOTHING. THESE RATINGS ARE BASED PRIMARILY ON QUANTITATIVE TEST RESULTS AND QUALITATIVE RESISTANCE INFORMATION. (THE RECOMMENDATIONS APPLY TO THE PURE SUBSTANCE ONLY; BREAKTHROUGH-TIME MAY VARY FOR MIXTURES.)

UNSUBSTITUTED ALIPHATIC HALOGEN COMPOUNDS: EXCELLENT/GOOD: VITON
FLUORINATED ETHYLENE PROPYLENE POLYMER OR POLYTETRAFLUOROETHYLENE
FAIR/POOR: NATURAL RUBBER NEOPRENE NEOPRENE/NATURAL RUBBER NITRILE
RUBBER POLYETHYLENE CHLORINATED POLYETHYLENE POLYVINYL CHLORIDE
FAIR/GOOD: BUTYL RUBBER NEOPRENE/STYRENE-BUTADIENE RUBBER
NITRILE/POLYVINYL CHLORIDE POLYURETHANE STYRENE-BUTADIENE RUBBER A WIDE
VARIATION IN RATINGS IS INDICATED FOR POLYVINYL ALCOHOL.

WEAR EYE PROTECTION TO PREVENT:

FOLLOWING INFORMATION FROM NIOSH/OSHA "OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS":

EMPLOYERS SHALL PROVIDE AND ENSURE THAT EMPLOYEES USE SPLASH-PROOF SAFETY GOGGLES WHICH COMPLY WITH 29CFR1910.133(A)(2)-(A)(6) WHERE THIS LIQUID MAY CONTACT THE EYES.

EMPLOYEE SHOULD WASH:

FOLLOWING INFORMATION FROM NIOSH/OSHA "OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS":

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE SKIN BECOMES WET WITH THIS SUBSTANCE PROMPTLY WASH OR SHOWER WITH SOAP OR MILD DETERGENT AND WATER TO REMOVE ANY CONTAMINANT FROM THE SKIN.

WORK CLOTHING SHOULD BE CHANGED DAILY:
NOT REQUIRED.

REMOVE CLOTHING:

FOLLOWING INFORMATION FROM NIOSH/OSHA "OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS":

EMPLOYERS SHALL ENSURE THAT ANY CLOTHING WHICH BECOMES WET WITH THIS FLAMMABLE LIQUID BE REMOVED IMMEDIATELY AND NOT REWORN UNTIL THE SUBSTANCE IS REMOVED FROM THE CLOTHING.

THE FOLLOWING EQUIPMENT SHOULD BE AVAILABLE:
NONE REQUIRED.

RF

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED):

1000 PPM

- POWERED AIR-PURIFYING RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE
- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE

WITH A FULL FACE-PIECE

4000 PPM

- SUPPLIED-AIR RESPIRATOR OPERATED IN CONTINUOUS FLOW MODE
- GAS MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONTOR BACK-MOUNTED CANISTER)
- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE
- SUPPLIED-AIR RESPIRATOR WITH A FULL FACE-PIECE

ESCAPE

- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE
- APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS

FIREFIGHTING

- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE.

MS

MEDICAL SURVEILLANCE:
BLOOD CHEMISTRY.
RENAL AND LIVER FUNCTIONS.

WITH EMPHASIS ON: RESPIRATORY HISTORY.

EKS RECOMMENDED IF EMPLOYEE TO WEAR FULL-FACE RESPIRATOR.

GENERAL MEDICAL HISTORY.

40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT TOXIC SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE REQUIRES MANUFACTURERS AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR 30 YEARS 48FR38187 08/22/83 48FR39225 08/30/83 (EFFECTIVE DATE CORRECTION).

VISION TEST.

PULMONARY FUNCTIONS.

14 BY 17 CHEST P.A. X-RAY.

PHYSICIAN EXAMINATION INDUSTRIAL EXPOSURE HISTORY.

SKIN EXAM.

RE

ROUTE OF ENTRY

INHALATION. INGESTION. SKIN OR EYE CONTACT.

TO

TARGET ORGANS:

EYES. SKIN. MUCCUS MEMBRANES. RESPIRATORY SYSTEM. CENTRAL NERVOUS SYSTEM. GASTROINTESTINAL.

SF

SYMPTOMS

EYE, ORGAN OF SIGHT (SC0170);

IRRITATION, EXTREME REACTION TO A CONDITION (SC0090). CONJUNCTIVITIS, INFLAMMATION OF EYES (SC0031).

MUCCUS MEMBRANE, MEMBRANE LINING PASSAGES/CAVITIES (SC0109);

IRRITATION, EXTREME REACTION TO A CONDITION (SC0090).

RESPIRATORY, PERTAINING TO THE LUNGS (SC0142);

IRRITATION, EXTREME REACTION TO A CONDITION (SC0090).

CENTRAL NERVOUS SYSTEM, PERTAINING TO NEURAL BODY SYSTEM (SC0028);

DEPRESSION, DECREASE IN ACTIVITY/FUNCTION (SC0043). DIZZINESS, FEELING FAINT, LIGHT-HEADED, UNSTEADY (SC0048). NARCOSIS, STUPOR OR SLEEP DUE TO

NARCOTIC (SC0113). NAUSEA, SICKNESS AT THE STOMACH (SC0115). VERTIGO,

FEELING OF WHIRLING MOTION (SC0163).

SKIN, COVERING OF BODY (SC0174);

IRRITATION, EXTREME REACTION TO A CONDITION (SC0090).

FA

FIRST AID

(1 OF 4)

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

(2 OF 4)

IF THIS CHEMICAL GETS ON THE SKIN, IMMEDIATELY WASH CONTAMINATED SKIN WITH SOAP OR MILD DETERGENT & WATER. IF THIS CHEMICAL SOAKS CLOTHING, IMMEDIATELY REMOVE CLOTHING & WASH SKIN WITH SOAP OR MILD DETERGENT & WATER. GET MEDICAL ATTENTION PROMPTLY.

(3 OF 4)

IF A PERSON BREATHE IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

(4 OF 4)

IF THIS HALOGENATED HYDROCARBON HAS BEEN SWALLOWED, REMOVE BY GASTRIC LAVAGE OR EMESIS. MAINTAIN BLOOD PRESSURE BY ADMINISTERING 5% GLUCOSE INTRAVENOUSLY. DO NOT GIVE STIMULANTS. GET FURTHER MEDICAL TREATMENT IMMEDIATELY. (DREISBACH - HANDBOOK OF POISONING, 11TH ED.).

DT

SPECIAL DIAGNOSTIC TESTS AND INDEXES OF EXPOSURE:

IF SYMPTOMS OF CENTRAL NERVOUS SYSTEM OCCUR, OBTAIN BLOOD GLUCOSE AND RECTAL TEMPERATURE. PERFORM COMPLETE NEUROLOGIC EXAMINATION AND ANY OTHER SPECIFIC NEUROLOGIC TESTS AS APPLICABLE. COMPLETE NEUROLOGIC EXAM.

AN ACCESSION NUMBER: 2785.1 8805.

CN CHEMICAL NAME: VINYLIDENE CHLORIDE.

SY SYNONYMS: 1,1-DICHLOROETHYLENE 1,1 DCE, SCONATEX, VDC, NCI C54262.

VINYLIDINE CHLORIDE. UN 1303. 1,1-DICHLOROETHENE. ETHYLENE,
1,1-DICHLORO-. ETHENE, 1,1-DICHLORO-. VINYLIDENE CHLORIDE(II).

RN CAS NUMBER: 75-35-4.

REG. TOXIC NUMBER: KV9275000.

CHEMICAL FORMULA: C2H2CL2.

PD

PHYSICAL DESCRIPTION:

COLORLESS LIQUID. MILD, SWEET ODOR RESEMBLING THAT OF CHLOROFORM.

MOL WT:	97
BOILING PT:	89 F
SOLUBILITY:	2250 MG/L AT 77 F
FLASH PT:	3 F
VAPOR PRES:	591 MM @ 25 C
MELT PT:	-188 F
UEL IN AIR:	16.0%
LEL IN AIR:	7.3%
MEC IN AIR:	1058 F
SPEC GRAVITY:	
VAPOR DENSITY:	3.4
ODOR THRESHOLD:	
OCTANOL/WATER CO-EFFICIENT:	

EL

PERMISSABLE EXPOSURE

5 PPM (20 MG/M3) ACGIH TWA

20 PPM (80 MG/M3) ACGIH STEL

INDEFINITE HUMAN CARCINOGEN (IARC)

ANIMAL CARCINOGEN (IARC)

NEGATIVE CARCINOGEN IN RATS/MICE (NCI, TR 288)

REPRODUCTIVE EFFECTS DATA (RTEC)

MUTAGENIC DATA (RTEC)

AQUATIC TOXICITY RATING 1/2 (TLM96 100 - 1000 PPM)

NO DATA LOCATED - RATED BY THE NATIONAL ACADEMY OF SCIENCES

CERCLA HAZARD RATINGS - TOXICITY 3 - IGNITABILITY 3 - REACTIVITY 2

PERSISTENCE 1

TOXICOLOGY: VINYLIDINE CHLORIDE IS A TOXIC EYE, SKIN, AND MUCOUS
MEMBRANE IRRITANT, CENTRAL NERVOUS SYSTEM DEPRESSANT, NEPHROTOXIN, AND
HEPATOXIN.

INGESTION OR INHALATION CAUSES COUGHING, DIZZINESS, DROWSINESS, AND
UNCONSCIOUSNESS. ALCOHOLIC BEVERAGES ENHANCE THE TOXIC EFFECTS.

VINYLIDENE CHLORIDE PRODUCES MALIGNANT TUMORS IN MICE AND RATS, SOME
OF WHICH ARE SIMILAR TO THOSE PRODUCED BY VINYL CHLORIDE.

~~THE THRESHOLD LIMIT VALUE IS BELIEVED LOW ENOUGH TO PREVENT OVERT~~
TOXICITY IN EXPOSED WORKERS.

IHL-HMN TCLO: 25 PPM

IHL-RAT LCLO: 10000 PPM/24 HR

IHL-MUS LC50: 98 PPM/22 HR

ORL-RAT LD50: 200 MG/KG

ORL-DOG LDLO: 5750 MG/KG

IVN-DOG LDLO: 225 MG/KG

SCU-RBT LDLO: 3700 MG/KG

OSHA STANDARD 29CFR1910.1200 HAZARD COMMUNICATION REQUIRES CHEMICAL MANUFACTURERS AND IMPORTERS TO ASSESS THE HAZARDS OF CHEMICALS WHICH THEY PRODUCE OR IMPORT, AND ALL EMPLOYERS HAVING WORKPLACES IN THE MANUFACTURING DIVISION, STANDARD INDUSTRIAL CLASSIFICATION CODES 20 THROUGH 39, TO PROVIDE INFORMATION TO THEIR EMPLOYEES CONCERNING HAZARDOUS CHEMICALS BY MEANS OF HAZARD COMMUNICATION PROGRAM INCLUDING LABELS, MATERIAL SAFETY DATA SHEETS, TRAINING, AND ACCESS TO WRITTEN RECORDS 48FR53280 11/25/83 FOLLOWING OSHA STANDARDS APPLICABLE TO SUBSTANCES LISTED 29CFR1910, OTHERWISE ADVISE.

DANGEROUS EXPOSURE

NONE SPECIFIED

COLORLESS LIQUID. MILD, SWEET.

IC

INCOMPATIBILITIES:

STRONG OXIDIZERS. STRONG ACIDS. STRONG BASES.

CL

CLOTHING

EMPLOYERS SHALL PROVIDE AND ENSURE THAT EMPLOYEES USE APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT NECESSARY TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE. FACE SHIELDS SHALL COMPLY WITH 29CFR1910.133(A)(2), (A)(4), (A)(5), AND (A)(6).

EMPLOYERS SHALL ENSURE THAT CLOTHING WET WITH THIS SUBSTANCE IS PLACED IN CLOSED CONTAINERS FOR STORAGE UNTIL IT CAN BE DISCARDED OR UNTIL THE EMPLOYER PROVIDES FOR THE REMOVAL OF THE CONTAMINANT FROM THE CLOTHING. IF THE CLOTHING IS TO BE LAUNDERED OR OTHERWISE CLEANED TO REMOVE THE CONTAMINANT, THE EMPLOYER SHALL INFORM THE PERSON PERFORMING THE CLEANING OPERATION OF THE HAZARDOUS PROPERTIES OF THE SUBSTANCE.

-ACGIH "GUIDELINES FOR THE SELECTION OF CHEMICAL PROTECTIVE CLOTHING" INDICATES THE FOLLOWING PROTECTIVE RATINGS FOR MATERIALS COMMONLY USED FOR PROTECTIVE CLOTHING. THESE RATINGS ARE BASED PRIMARILY ON QUANTITATIVE TEST RESULTS AND QUALITATIVE RESISTANCE INFORMATION. (THE RECOMMENDATIONS APPLY TO THE PURE SUBSTANCE ONLY; BREAKTHROUGH TIME MAY VARY FOR MIXTURES.)

VINYLDENE CHLORIDE: EXCELLENT/GOOD; NONE INDICATED FAIR/GOOD;
CHLORINATED POLYETHYLENE.

WEAR EYE PROTECTION TO PREVENT:

EMPLOYERS SHALL PROVIDE AND ENSURE THAT EMPLOYEES USE SPLASH-PROOF SAFETY GOGGLES WHICH COMPLY WITH 29CFR1910.133(A)(2)-(A)(6) WHERE THIS LIQUID MAY CONTACT THE EYES.

EMPLOYEE SHOULD WASH:

EMPLOYERS SHALL ENSURE THAT EMPLOYEES WHOSE SKIN BECOMES WET WITH THIS SUBSTANCE PROMPTLY WASH OR SHOWER TO REMOVE ANY CONTAMINANT FROM THE SKIN.

WORK CLOTHING SHOULD BE CHANGED DAILY:

NOT REQUIRED.

REMOVE CLOTHING:

EMPLOYERS SHALL ENSURE THAT ANY CLOTHING WHICH BECOMES WET WITH THIS FLAMMABLE LIQUID BE REMOVED IMMEDIATELY AND NOT REWORN UNTIL THE SUBSTANCE IS REMOVED FROM THE CLOTHING.

THE FOLLOWING EQUIPMENT SHOULD BE AVAILABLE:

EMPLOYERS SHALL ENSURE THAT EMPLOYEES DO NOT EAT OR DRINK IN AREAS WHERE THIS SUBSTANCE IS HANDLED, PROCESSED OR STORED.

RF

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED):

10 PPM

- TYPE 'C' SUPPLIED-AIR RESPIRATOR
- SUPPLIED-AIR RESPIRATOR
WITH HALF-MASK
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE
- AUXILIARY SELF-CONTAINED BREATHING APPARATUS
- CHEMICAL CARTRIDGE RESPIRATOR
- WITH AN ORGANIC VAPOR CANISTER
PROVIDING PROTECTION AGAINST SPECIFIC COMPOUND OF CONCERN

25 PPM

- POWERED AIR-PURIFYING RESPIRATOR
WITH A FULL FACE-PIECE, HELMET, OR HOOD
PROVIDING PROTECTION AGAINST SPECIFIC COMPOUND OF CONCERN
- GAS MASK
(CHIN-STYLE OR FRONTOR BACK-MOUNTED CANISTER)
PROVIDING PROTECTION AGAINST SPECIFIC COMPOUND OF CONCERN

100 PPM

- TYPE 'C' SUPPLIED-AIR RESPIRATOR
- SUPPLIED-AIR RESPIRATOR
WITH A FULL FACE-PIECE
- AUXILIARY SELF-CONTAINED BREATHING APPARATUS
- SELF-CONTAINED BREATHING APPARATUS
WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE
- TYPE 'C' SUPPLIED-AIR RESPIRATOR
- SUPPLIED-AIR RESPIRATOR
WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

1000 PPM

- TYPE 'C' SUPPLIED-AIR RESPIRATOR
- SUPPLIED-AIR RESPIRATOR
WITH A FULL FACE-PIECE
- AUXILIARY SELF-CONTAINED BREATHING APPARATUS
- TYPE 'C' SUPPLIED-AIR RESPIRATOR
- SUPPLIED-AIR RESPIRATOR
WITH HALF-MASK
- AUXILIARY SELF-CONTAINED BREATHING APPARATUS

>3500 PPM

- SELF-CONTAINED BREATHING APPARATUS
WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND, POSITIVE-PRESSURE, OR CONTINUOUS-FLOW

MODE

FIREFIGHTING

- SELF-CONTAINED BREATHING APPARATUS
WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE

15
MEDICAL SURVEILLANCE:

~~NO EXAM REQUIRED UNLESS EMPLOYEE TO WEAR FULL FACE-PIECE RESPIRATOR.~~
ATTENTION TO SMOKING, ALCOHOL, MEDICATION, AND EXPOSURE TO CARCINOGENS.
GENERAL MEDICAL HISTORY.

~~40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES~~
CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT TOXIC
SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE REQUIRES MANUFACTURERS
AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP
RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR 30 YEARS
48FR38187 08/22/83 48FR39225 08/30/83 (EFFECTIVE DATE CORRECTION).

~~RESPIRATORY HISTORY~~ -----

~~PRE-PLACEMENT AND ANNUAL EXAMS.~~

~~PHYSICIAN EXAMINATION INDUSTRIAL EXPOSURE HISTORY.~~

~~VISION TEST.~~

~~HISTORY OF HEPATITIS, BLOOD TRANSFUSIONS, HOSPITALIZATION.~~

~~BLOOD CHEMISTRY.~~

~~COMPLETE BLOOD COUNT.~~

~~CHRONIC RESPIRATORY DISEASE.~~

~~LIVER FUNCTION.~~

~~ELECTROCARDIOGRAM.~~

~~URINALYSIS.~~

~~14 BY 17 CHEST P.A. X-RAY.~~

~~ALKALINE PHOSPHATASE.~~

~~GGTP.~~

~~SGOT.~~

~~SGPT.~~

~~DIRECT BILIRUBIN.~~

~~DIRECT BILIRUBIN.~~

~~LDH.~~

RE

ROUTE OF ENTRY

~~INHALATION. INGESTION. SKIN OR EYE CONTACT.~~

TO

TARGET ORGANS:

~~EYES. SKIN. MUCOUS MEMBRANES. RESPIRATORY SYSTEM. CENTRAL NERVOUS~~
SYSTEM. RESPIRATORY SYSTEM. KIDNEYS. LIVER.

SP

SYMPTOMS

~~SKIN, COVERING OF BODY (SC0174);~~

~~IRRITATION, EXTREME REACTION TO A CONDITION (SC0090).~~

~~MUCOUS MEMBRANE, MEMBRANE LINING PASSAGES/CAVITIES (SC0109);~~

~~IRRITATION, EXTREME REACTION TO A CONDITION (SC0090). CONJUNCTIVITIS,~~

~~INFLAMMATION OF EYES (SC0031). WEIGHT LOSS, DROP IN BODY WEIGHT~~

~~(SC0104). NARCOSIS, STUPOR OR SLEEP DUE TO NARCOTIC (SC0113).~~

~~CENTRAL NERVOUS SYSTEM, PERTAINING TO NEURAL BODY SYSTEM (SC0028);~~

~~DEPRESSION, DECREASE IN ACTIVITY/FUNCTION (SC0043). MAMMARY~~

~~ADENOCARCINOMA, MALIGNANT BREAST TUMOR (SC0235). DERMATITIS,~~

~~INFLAMMATION OF SKIN (SC0044).~~

~~CARDIAC, PERTAINING TO HEART (SC0023);~~

~~ARRHYTHMIA, ABSENCE OF RHYTHM; IRREGULARITY (SC0010).~~

~~RESPIRATORY, PERTAINING TO THE LUNGS (SC0142);~~

~~EDEMA, FLUID RETENTION WITH SWELLING (SC0181). LIVER DAMAGE, INJURY TO~~

~~THE LIVER (SC0221). KIDNEY DAMAGE, INJURY TO THE KIDNEY (SC0220).~~

~~EYE, ORGAN OF SIGHT (SC0170);~~

~~IRRITATION, EXTREME REACTION TO A CONDITION (SC0090).~~

~~SKIN, COVERING OF BODY (SC0174);~~

~~IRRITATION, EXTREME REACTION TO A CONDITION (SC0090).~~

~~REPRODUCTIVE EFFECTS, BIRTH DEFECTS (SC0281);~~

~~IN EXPERIMENTAL ANIMALS. (SC0212).~~

FIRST AID

(1 OF 4)

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

(2 OF 4)

IF THIS CHEMICAL GETS ON THE SKIN, IMMEDIATELY WASH CONTAMINATED SKIN WITH SOAP OR MILD DETERGENT & WATER. IF THIS CHEMICAL SOAKS CLOTHING, IMMEDIATELY REMOVE CLOTHING & WASH SKIN WITH SOAP OR MILD DETERGENT & WATER. GET MEDICAL ATTENTION PROMPTLY.

(3 OF 4)

IF A PERSON BREATHES IN LARGE AMOUNTS OF THIS CHEMICAL, MOVE THE EXPOSED PERSON TO FRESH AIR AT ONCE. IF BREATHING HAS STOPPED PERFORM ARTIFICIAL RESPIRATION. KEEP THE AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

(4 OF 4)

IF THIS HALOGENATED HYDROCARBON HAS BEEN SWALLOWED, REMOVE BY GASTRIC LAVAGE OR EMESIS. MAINTAIN BLOOD PRESSURE BY ADMINISTERING 5% GLUCOSE INTRAVENOUSLY. DO NOT GIVE STIMULANTS. GET FURTHER MEDICAL TREATMENT IMMEDIATELY. (DREISBACH - HANDBOOK OF POISONING, 11TH ED.).

SPECIAL DIAGNOSTIC TESTS AND INDEXES OF EXPOSURE:
NONE IN COMMON USE.

REGULATORY

AN ACCESSION NUMBER: 2648. 9805.

CN CHEMICAL NAME: **TRICHLOROETHYLENE**

SY SYNONYMS: ~~TRICHLOROETHENE, POW TRI, NCI C04546, CHLORYLEN,~~
CECOLENE, TRILENE, TCE, UN 1710, ETHYLENE, TRICHLORO-,
1-CHLORO-2,2-DICHLOROETHYLENE, 1,1-DICHLORO-2-CHLOROETHYLENE,
1,1,2-TRICHLOROETHYLENE, 1,2,2-TRICHLOROETHYLENE, ETHYLENE TRICHLORIDE,
ETHINYL TRICHLORIDE, TRICHLOROETHYLENE, TRIAD, THRETHYLENE,
TRETHYLENE, LANADIN.

RN CAS NUMBER: 79-01-6.

REG. TOXIC NUMBER: KX4550000.

CHEMICAL FORMULA: C₂HCL₃.

PD

PHYSICAL DESCRIPTION:

COLORLESS MOBILE LIQUID; CHLOROFORM-LIKE ODOR; PHOTOREACTIVE.

MOL WT:	131
BOILING PT:	189 F
SOLUBILITY:	0.1%
FLASH PT:	90 F *
VAPOR PRES:	58 MM
MELT PT:	-99 F
UEL IN AIR:	90%
LEL IN AIR:	12.5%
MEC IN AIR:	788 F
SPEC GRAVITY:	1.4642
VAPOR DENSITY:	4.5
ODOR THRESHOLD:	20 PPM
OCTANOL/WATER CO-EFFICIENT:	

EL

PERMISSABLE EXPOSURE

100 PPM OSHA TWA - 200 PPM OSHA CEILING
300 PPM OSHA 5-MINUTE PEAK
50 PPM ACGIH TWA - 200 PPM ACGIH STEL
25 PPM NIOSH 10HR TWA

INDEFINITE HUMAN CARCINOGEN (IARC) - ANIMAL CARCINOGEN (IARC)
POSITIVE CARCINOGEN IN MICE; NEGATIVE CARCINOGEN IN RATS (NCI, 1976)
~~POSITIVE CARCINOGEN IN MICE; INADEQUATE STUDY IN RATS (NCI, 1984)~~
TERATOGENIC DATA (RTEC); MUTAGENIC DATA (RTEC)
AQUATIC TOXICITY RATING 1/2 (TLM96 100 - 1000 PPM)
LC RANGE, 96H (IN SEA WATER) - PLAICE 15 PPM
CERCLA HAZARD RATINGS - TOXICITY 1 - IGNITABILITY 1 - REACTIVITY 0 -
PERSISTENCE 2

TOXICOLOGY: ~~TRICHLOROETHYLENE IS AN EYE, MUCOUS MEMBRANE, AND PRIMARY~~
~~SKIN IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT.~~
~~ACUTE EXPOSURE DEPRESSES THE NERVOUS SYSTEM, AND MAY DAMAGE THE GASTRO-~~
~~INTESTINAL TRACT, LIVER AND KIDNEYS. THE PRESENCE OF TETRACHLOROETHANE~~
~~INCREASES IN COMMERCIAL GRADES INCREASES THE CELLULAR TOXICITY.~~
~~CHRONIC INHALATION OR ABSORPTION CAUSES CENTRAL NERVOUS SYSTEM~~
~~EFFECTS, JOINT PAIN, DERMATITIS, AND POSSIBLY JAUNDICE. INGESTION OF~~
~~ALCOHOL MAY INCREASE THE TOXICITY OF TRICHLOROETHYLENE.~~
~~TRICHLOROETHYLENE IS A MILD RESPIRATORY IRRITANT.~~
~~THE THRESHOLD LIMIT VALUE WAS ESTABLISHED TO PREVENT TOXIC EFFECTS.~~

IHL-HMN TCLO: 5900 MG/M3/10 MIN

IHL-HMN TCLO: 160 PPM/83 MIN

IHL-HMN TCLO: 812 MG/KG

IHL-MAN TCLO: 110 PPM/3 HR

IHL-MAN TCLO: 2900 PPM

IHL-HMN LCLO: 7 GM/KG

ORL-RAT LD50: 4920 MG/KG

ORL-MUS LD50: 2402 MG/KG

IHL-RAT LCLO: 9000 PPM/4 HR

IHL-CAT LCLO: 32500 MG/M3/2 HR

RESPIRATOR SELECTION (UPPER LIMIT DEVICES PERMITTED):

ANY DETECTABLE CONC.

~~SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE~~

~~- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE WITH AUXILIARY
SELF-CONTAINED BREATHING APPARATUS OPERATED IN POSITIVE PRESSURE MODE~~

ESCAPE

~~- GAS MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONTOR
BACK-MOUNTED CANISTER)~~

~~- APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS~~

FIREFIGHTING

~~SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE
OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE.~~

MS

~~MEDICAL SURVEILLANCE:~~

GENERAL MEDICAL HISTORY.

~~40CFR717 RECORDS AND REPORTS OF ALLEGATIONS THAT CHEMICAL SUBSTANCES
CAUSE SIGNIFICANT ADVERSE REACTIONS TO HEALTH OR THE ENVIRONMENT TOXIC
SUBSTANCES CONTROL ACT (TSCA) SECTION 8(C) RULE REQUIRES MANUFACTURERS
AND CERTAIN PROCESSORS OF CHEMICAL SUBSTANCES AND MIXTURES TO KEEP
RECORDS OF SIGNIFICANT ADVERSE REACTIONS TO EMPLOYEE HEALTH FOR 30 YEARS
48FR38187 08/22/83 48FR39225 08/30/83 (EFFECTIVE DATE CORRECTION).~~

RESPIRATORY HISTORY.

~~PRE-PLACEMENT AND ANNUAL EXAMS.~~

~~WITH EMPHASIS ON: RENAL AND LIVER FUNCTIONS.~~

~~BLOOD CHEMISTRY.~~

~~COMPLETE BLOOD COUNT.~~

~~WITH EMPHASIS ON: PULMONARY FUNCTIONS.~~

~~WITH EMPHASIS ON: CENTRAL NERVOUS SYSTEM TESTS, PERIPHERAL NEUROPATHY.~~

~~WITH EMPHASIS ON: ELECTROCARDIOGRAM.~~

~~WITH EMPHASIS ON: SKIN EXAM.~~

~~VISION TEST.~~

~~URINALYSIS.~~

~~ATTENTION TO SMOKING, ALCOHOL, MEDICATION, AND EXPOSURE TO CARCINOGENS.~~

~~WITH EMPHASIS ON: 14 BY 17 CHEST P.A. X-RAY.~~

~~ADDITION BIOLOGICAL EXPOSURE INDICES FOR TRICHLOROETHYLENE: 100 MG/L~~

~~TRICHLOROACETIC ACID IN URINE / TIMING -END OF WORKWEEK 300 MG/L~~

~~TRICHLOROACETIC ACID AND TRICHLOROETHANOL IN URINE / TIMING -END OF~~

~~WORKWEEK AND END OF SHIFT 320 MG/G CREAT. TRICHLOROACETIC ACID AND~~

~~TRICHLOROETHANOL IN URINE/ TIMING -END OF WORKWEEK AND END OF SHIFT 4~~

~~MG/L FREE TRICHLOROETHANOL IN BLOOD / TIMING -END OF SHIFT AND END OF~~

~~WORKWEEK 0.5 PPM TRICHLOROETHYLENE IN END-EXHALED AIR / TIMING -PRIOR TO~~

~~SHIFT AND END OF WORKWEEK.~~

RE

ROUTE OF ENTRY

~~INHALATION. INGESTION. SKIN OR EYE CONTACT.~~

TO

TARGET ORGANS:

~~RESPIRATORY SYSTEM. SKIN. HEART. LIVER. KIDNEYS. CENTRAL NERVOUS
SYSTEM.~~

SE

SYMPTOMS:

HEADACHE, PAIN IN HEAD OR CRANIUM AREA (SC0075). VERTIGO, FEELING OF WHIRLING MOTION (SC0163). VISUAL DISTURBANCE, UPSET IN SIGHT (SC0165). TREMORS, TREMBLING, SHAKING (SC0197). SOMNOLENCE, PROLONGED SLEEPINESS (SC0152). DERMATITIS, INFLAMMATION OF SKIN (SC0044). NAUSEA, SICKNESS AT THE STOMACH (SC0115). VOMITING, PERTAINING TO NAUSEA (SC0166).

CARDIAC, PERTAINING TO HEART (SC0023); ARRHYTHMIA, ABSENCE OF RHYTHM; IRREGULARITY (SC0010). PARESTHESIA, ABNORMAL SENSATION WITHOUT CAUSE (SC0125). NARCOSIS, STUPOR OR SLEEP DUE TO NARCOTIC (SC0113). ANESTHESIA, LOSS OF SENSATION (SC0005). LIVER DAMAGE, INJURY TO THE LIVER (SC0221). IRRITABILITY, QUICK EXCITABILITY TO ANNOYANCE (SC0091).

CENTRAL NERVOUS SYSTEM, PERTAINING TO NEURAL BODY SYSTEM (SC0028); DEPRESSION, DECREASE IN ACTIVITY/FUNCTION (SC0043). VENTRICULAR

FIBRILLATION, RAPID CONTRACTIONS OF VENTRICLES (SC0162).

CARDIAC, PERTAINING TO HEART (SC0023);

DEGENERATION, DETERIORATION, A WORSENING (SC0040).

CENTRAL NERVOUS SYSTEM, PERTAINING TO NEURAL BODY SYSTEM (SC0028);

DEGENERATION, DETERIORATION, A WORSENING (SC0040). KIDNEY DAMAGE, INJURY TO THE KIDNEY (SC0220). UNCONSCIOUSNESS, NOT AWAKE; INSENSIBLE (SC0198). JAUNDICE, YELLOWING OF SKIN, EYES (SC0092). WHEEZING, NOISY BREATHING WITH DIFFICULTY (SC0168). UNCONSCIOUSNESS, NOT AWAKE; INSENSIBLE (SC0198). DIZZINESS, FEELING FAINT, LIGHT-HEADED, UNSTEADY (SC0048). EXCITATION, CENTRAL NERVOUS SYSTEM STIMULATION

(SC0289). IRREGULAR PULSE, ALTERNATING WEAK AND STRONG PULSE (SC0143). ARTHRALGIA, JOINT PAIN (SC0417).

RESPIRATORY, PERTAINING TO THE LUNGS (SC0142);

EDEMA, FLUID RETENTION WITH SWELLING (SC0181). WHEEZING, NOISY BREATHING WITH DIFFICULTY (SC0168). WEIGHT LOSS, DROP IN BODY WEIGHT (SC0104). ANOREXIA, DIMINISHED APPETITE (SC0006). FATIGUE, TIREDNESS, SLUGGISH (SC0066).

REPRODUCTIVE EFFECTS, BIRTH DEFECTS (SC0281); IN EXPERIMENTAL ANIMALS, (SC0212).

FA

FIRST AID.

(1 OF 8)

IF THIS CHEMICAL GETS INTO THE EYES, IMMEDIATELY WASH THE EYES WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE LOWER AND UPPER LIDS. GET MEDICAL ATTENTION IMMEDIATELY. CONTACT LENSES SHOULD NOT BE WORN WHEN WORKING WITH THIS CHEMICAL.

(2 OF 8)

IF THIS CHEMICAL GETS ON THE SKIN, IMMEDIATELY WASH CONTAMINATED SKIN WITH SOAP OR MILD DETERGENT & WATER. IF THIS CHEMICAL SOAKS CLOTHING, IMMEDIATELY REMOVE CLOTHING & WASH SKIN WITH SOAP OR MILD DETERGENT & WATER. GET MEDICAL ATTENTION PROMPTLY.

(3 OF 8)

IF THIS CHEMICAL GETS ON SKIN, IMMEDIATELY FLUSH CONTAMINATED SKIN WITH WATER. IF THIS CHEMICAL PENETRATES CLOTHING, IMMEDIATELY REMOVE THE CLOTHING AND FLUSH THE SKIN WITH WATER. GET MEDICAL ATTENTION PROMPTLY.

(4 OF 8)

WHEN THIS CHEMICAL HAS BEEN SWALLOWED AND PERSON IS CONSCIOUS, IMMEDIATELY GIVE PERSON LARGE QUANTITIES OF WATER. AFTER WATER HAS BEEN SWALLOWED, TRY TO GET THE PERSON TO VOMIT BY HAVING HIM TOUCH THE BACK OF HIS THROAT WITH HIS FINGER. DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT. GET MEDICAL ATTENTION IMMEDIATELY.

(5 OF 8)

VOLATILE AND GASEOUS ANESTHETICS: EMERGENCY TREATMENT - ESTABLISH AIRWAY AND MAINTAIN RESPIRATION. REMOVE ANESTHETIC BY FORCED VENTILATION. FURTHER TREATMENT - MAINTAIN BLOOD PRESSURE BY INTRAVENOUS SALINE OR BLOOD TRANSFUSION. MAINTAIN BODY WARMTH. MAINTAIN ADEQUATE AIRWAY BY REMOVING SECRETIONS FROM TRACHEA BY CATHETER SUCTION. PREVENT HYPOXIA. IF HYPERTHERMIA OCCURS, LOWER BODY TEMPERATURE BY APPLICATION OF WET TOWELS. FOR MALIGNANT HYPERTHERMIA, GIVE DANTROLENE SODIUM, 1 MG/KG, EVERY FIFTEEN MINUTES, INTRAVENOUSLY TO A TOTAL OF 10 MG/KG, AND PROCAINAMIDE, 15 MG/KG, INTRAVENOUSLY, OVER TEN MINUTES. GIVE ICED NORMAL SALINE INTRAVENOUSLY AT A RATE OF 1 LITER EVERY TEN MINUTES FOR THIRTY MINUTES. LAVAGE STOMACH, URINARY BLADDER, RECTUM, AND PERITONEUM WITH ICED SALINE. TREAT ACIDOSIS WITH INTRAVENOUS SODIUM BICARBONATE. MONITOR SERUM TOTAL BASE, SERUM POTASSIUM, AND ARTERIAL PH AND TREAT APPROPRIATELY. MAINTAIN URINE OUTPUT AT 1-2 LITERS DAILY WITH FURSEMITIDE AND MANNITOL. AFTER FIRST DAY, GIVE DANTROLENE, 1 MG/KG ORALLY DAILY, FOR THREE DAYS. (MEDICATION MUST BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL) SPECIAL TREATMENT - TREAT LIVER DAMAGE. (DREISSBACH, HANDBOOK OF POISONING, 11TH ED.).

First Aid cont.

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GASTRIC LAVAGE - GIVE PATIENT GLASS OF WATER PRIOR TO PASSING OF STOMACH TUBE. LAY PATIENT ON ONE SIDE, WITH HEAD LOWER THAN WAIST. IMMOBILIZE A STRUGGLING PATIENT WITH A SHEET OR BLANKET. MEASURE DISTANCE ON TUBE FROM MOUTH TO EPIGASTRIUM, MARK TUBE WITH INDELIBLE MARKING OR TAPE. REMOVE DENTURES AND OTHER FOREIGN OBJECTS FROM MOUTH. OPEN MOUTH, USE GAG IF NECESSARY. EXTEND HEAD BY LIFTING THE CHIN. PASS TUBE OVER TONGUE AND TOWARD BACK OF THROAT WITHOUT EXTENDING HEAD OR NECK. IF OBSTRUCTION IS MET BEFORE THE MARK ON TUBE REACHES LEVELS OF TEETH, DO NOT FORCE, BUT REMOVE TUBE AND REPEAT PROCEDURE UNTIL TUBE PASSES TO MARK. PLACE END OF TUBE IN GLASS OF WATER. IF TUBE IS OBSTRUCTED WHEN INTRODUCED ABOUT HALFWAY TO THE MARK, IT MAY HAVE ENTERED TRACHEA. AFTER TUBE IS PLACED IN STOMACH, ASPIRATE FIRST TO REMOVE STOMACH CONTENTS BY IRRIGATION SYRINGE. SAVE STOMACH CONTENTS FOR EXAMINATION, AND REPEAT INTRODUCTION AND WITHDRAWAL OF 100-300 ML WARM WATER UNTIL AT LEAST 3 LITERS OF CLEAR RETURN ARE OBTAINED. USE ACTIVATED CHARCOAL AT BEGINNING OF LAVAGE TO AID IN POISON INACTIVATION. LEAVE 50 GRAMS OF CHARCOAL SUSPENDED IN WATER IN THE STOMACH. IF INTRODUCTION AND REMOVAL OF LAVAGE FLUID BY GRAVITY REQUIRES MORE THAN FIVE MINUTES, ASSIST WITH ASEPTIC SYRINGE. PREVENT ASPIRATION WITH CUFFED ENDOTRACHEAL TUBE. AVOID GIVING LARGE QUANTITIES OF WATER. MASSAGE OF EPIGASTRIUM WHILE STOMACH TUBE IS BEING ASPIRATED MAY AID IN POISON REMOVAL. IF PATIENT COMATOSE, INTUBATE TRACHEA WITH CUFFED ENDOTRACHEAL TUBE. SUCCINYLCHLORINE MAY BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL TO EASE INSERTION OF TRACHEAL CATHETER PRIOR TO PASSAGE OF STOMACH TUBE. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.).

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PULMONARY EDEMA - RELIEVE ANXIETY. GIVE MORPHINE SULFATE, 10 MG, TO DECREASE RATE OF RAPID, INEFFICIENT RESPIRATION. GIVE 40% OXYGEN BY FACE MASK. USE INTERMITTENT POSITIVE-PRESSURE OXYGEN RESUSCITATOR FOR SHORT PERIODS. GIVE AMINOPHYLLINE, 0.5 G, INTRAVENOUSLY, TO RELIEVE ASSOCIATED BRONCHIAL CONSTRICTION. TREAT EDEMA CAUSED BY MORPHINE OR MORPHINE ANALOGS BY GIVING HALOXONE AND OXYGEN. (MEDICATION MUST BE GIVEN BY QUALIFIED MEDICAL PERSONNEL) (DREISBACH, HANDBOOK OF POISONING, 11TH ED.).

(8 OF 8)

LIVER DAMAGE - REMOVE FROM EXPOSURE TO ALL CHEMICALS AND DRUGS. MAINTAIN COMPLETE BED REST. AVOID ANESTHESIA OR SURGICAL PROCEDURES. AVOID DEHYDRATION OR OVERHYDRATION. IF VOMITING SEVERE AND ORAL FLUIDS NOT RETAINED, REPLACE VOMITUS WITH AN EQUAL QUANTITY OF 10% DEXTROSE IN NORMAL SALINE. IN RENAL FUNCTION ADEQUATE, GIVE 1 LITER OF 5% DEXTROSE OR INVERT SUGAR IN NORMAL SALINE PLUS 1-3 LITERS OF 10% DEXTROSE OR INVERT SUGAR IN DISTILLED WATER INTRAVENOUSLY EVERY TWENTY-FOUR HOURS. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.).

DT

SPECIAL DIAGNOSTIC TESTS AND INDEXES OF EXPOSURE:
URINE TRICHLOROETHYLENE METABOLITES >20 MG/DAY.

TECHNICAL SPECIFICATIONS, COST BREAKDOWN
AND AGREEMENT FORM

FOR

Soil Boring, Monitoring Well Construction and
Related Geotechnical Services

at

USARC Training Area - 84th Division
Milwaukee, Wisconsin

Prepared For

Department of the Army
Project No. HA01005-8P
Ft. McCoy, Wisconsin

Prepared by
Donohue & Associates, Inc.,
November, 1988
Project No. 15977.007

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M/P/IQ9		

This document has important legal consequences: consultation with an attorney is encouraged with respect to its completion or modification.

STANDARD FORM OF AGREEMENT
BETWEEN
ENGINEER AND GEOTECHNICAL ENGINEER
FOR
PROFESSIONAL SERVICES

THIS IS AN AGREEMENT made as of _____, 19____
between Donohue & Associates, Inc., 4738 N. 40th Street, P.O. Box 1067
Sheboygan, Wisconsin 53083 (ENGINEER) and

Twin City Testing Corporation (GEOTECHNICAL ENGINEER).

A. ENGINEER has made an agreement dated _____, 19____
with Department of the Army-Ft. McCoy; Sparta, Wisconsin (OWNER)

which is herein referred to as the Prime Agreement and which provides for ENGINEER's performing professional services in connection with the Project described therein. ENGINEER hereby engages GEOTECHNICAL ENGINEER to perform for ENGINEER geotechnical engineering services in connection with said Project in accordance with the terms and conditions of this Agreement between ENGINEER and GEOTECHNICAL ENGINEER ("this Agreement").

The Project is described in the Prime Agreement as follows:

PROJECT LOCATION AND DESCRIPTION:

Two groundwater observation wells and two intermediate piezometers shall be installed during this investigation to evaluate whether groundwater contamination has resulted from former landfilling operations conducted on-site. Prior investigations have demonstrated that vinyl chloride, 1,2 dichloroethylene 1,1 dichloroethene, trichloroethylene (TCE) as well as other volatile organic compounds occur in the groundwater at this site. The source of this contamination is not currently known.

B. The services to be performed by GEOTECHNICAL ENGINEER are generally described as follows:

SCOPE OF SERVICES

The GEOTECHNICAL ENGINEER shall provide all necessary documentation and items of equipment, materials, labor, supervision, tools, temporary structures, and other supplies and materials required for the completion of the work at this site to include:

- * Prepare a site-specific Health & Safety Plan specifying procedures and equipment needed to protect personnel from on-site hazards.
- * Conduct soil boring and/or rock drilling (as required) activities at two (2) locations along the western side of the property (well nests 112A, 112B and 113A, 113B). One 20-foot observation well, and one 45-foot piezometer will be installed at each location.
- * Collect soil samples at 5-foot depth increments and describe according to the USCS Classification System. Document soil stratigraphy by complete boring logs.
- * Document well construction methods and materials by completing a well installation diagram for each well (Attachment B).
- * Decontaminate equipment between successive locations.
- * Develop each newly-installed well. (Attachment C).
- * Determine well locations and elevations by conducting on-site survey.
- * Prepare report summarizing the results of the field investigation, to include completed boring logs, well construction diagrams, well development forms and site survey data.
- * Perform other work activities as necessary according to Technical Specifications (Part III).

ENGINEER and GEOTECHNICAL ENGINEER in consideration of their mutual covenants herein agree with respect to the performance of services by GEOTECHNICAL ENGINEER and the payment for those services by ENGINEER as set forth below.

ENGINEER is the prime professional with respect to the services to be performed under this Agreement and is responsible for coordinating GEOTECHNICAL ENGINEER's services with the services of others involved in the Project. GEOTECHNICAL ENGINEER is ENGINEER's independent consultant and shall be responsible for the means and methods used in performing geotechnical engineering services under this Agreement, and is not a joint-venturer with ENGINEER. ENGINEER shall be the general administrator and coordinator of the professional services for the Project, and shall facilitate the exchange of information among the independent professional associates and consultants retained by ENGINEER for the Project as necessary for the coordination of their services.

SECTION I—BASIC SERVICES OF GEOTECHNICAL ENGINEER

1.1. General.

1.1.1. The duties and responsibilities of GEOTECHNICAL ENGINEER as set forth in this Section I are amended and supplemented as indicated in Exhibit EG-B which is attached hereto, made a part hereof and entitled "Further Description of Basic Services and Related Matters".

1.1.2. GEOTECHNICAL ENGINEER shall provide professional geotechnical engineering services for ENGINEER in all phases of the Project to which this Agreement applies. These services include professional geotechnical engineering consultation and advice to ENGINEER, and through or with the knowledge of ENGINEER, to OWNER and other concerned parties as required to be provided by ENGINEER under the Prime Agreement.

1.1.3. GEOTECHNICAL ENGINEER is responsible for obtaining all data and information (other than that specifically designated herein or in the Prime Agreement to be furnished by ENGINEER or OWNER) necessary for the performance of the required geotechnical engineering services.

1.1.4. GEOTECHNICAL ENGINEER is responsible to see that the documents and services furnished by GEOTECHNICAL ENGINEER conform to the applicable laws, rules, regulations, codes, orders and special requirements of the place where the Project is located, except as may be specifically provided otherwise in Exhibit EG-B "Further Description of Basic Services and Related Matters".

1.1.5. All of GEOTECHNICAL ENGINEER's communications to or with OWNER, ENGINEER's other independent professional associates and consultants, or other parties involved in the Project will be through or with the knowledge of ENGINEER.

1.2. Field Explorations.

After written authorization from ENGINEER to proceed, GEOTECHNICAL ENGINEER shall:

1.2.1. Review information furnished by OWNER and ENGINEER and consult with OWNER and ENGINEER to clarify and define geotechnical requirements for the Project.

1.2.2. Perform geologic examinations and subsurface explorations of the Project site, as described in Exhibit EG-B "Further Description of Basic Services and Related Matters".

1.2.3. Within limits of information provided to GEOTECHNICAL ENGINEER under paragraph 3.3 of this Agreement or otherwise known to GEOTECHNICAL ENGI-

NEER minimize damage to existing property and utilities above and below grade.

1.2.4. Cover all open test holes with substantial covers during periods of inactivity and backfill all test holes upon completion of field explorations.

1.2.5. Preserve and make available for inspection by ENGINEER, OWNER and construction Contractor(s) all samples for the time and in the manner specified in Exhibit EG-B "Further Description of Basic Services and Related Matters". If requested in writing by ENGINEER, samples will be delivered to the Project site or other location designated by ENGINEER, and GEOTECHNICAL ENGINEER will be reimbursed for the delivery costs.

1.3. Tests.

After written authorization from ENGINEER to proceed:

1.3.1. GEOTECHNICAL ENGINEER shall perform the tests needed by GEOTECHNICAL ENGINEER to supply information to ENGINEER for the Project, and required for reviewing the geotechnical aspects of the work of Contractor(s) as described in Exhibit EG-B "Further Description of Basic Services and Related Matters".

1.3.2. All tests shall be performed in accordance with applicable standards by qualified, experienced personnel with testing facilities specifically suited for the required tests.

1.4. Analyses and Report.

After written notice from ENGINEER to proceed:

1.4.1. GEOTECHNICAL ENGINEER shall analyze the results of field explorations and tests and prepare a written Report thereon.

1.4.2. The Report shall contain geotechnical information required by ENGINEER for the Project and shall be suitable for reproduction. Unless designated otherwise in Exhibit EG-B "Further Description of Basic Services and Related Matters", the Report shall include:

1.4.2.1. Descriptions of field explorations and tests.

1.4.2.2. Professional interpretations of the foregoing as appropriate for ENGINEER's purposes.

1.4.2.3. Summary of the findings with appropriate exhibits to indicate the geotechnical considerations involved and setting forth recommendations with criteria for design and construction of the Project.

1.4.3. Furnish five copies of the Report to ENGINEER and unless notified otherwise by ENGINEER, review it in person with ENGINEER.

1.5. Review of ENGINEER's Analyses and Documents.

At appropriate times requested by ENGINEER, GEOTECHNICAL ENGINEER shall:

1.5.1. Review ENGINEER's studies and designs for conformance with recommendations and criteria presented in GEOTECHNICAL ENGINEER's Report and render advice on changes that may be advisable.

1.5.2. Review ENGINEER's proposed Contract Documents and opinion of probable construction cost in respect of the geotechnical aspects of the Project and render advice on changes that may be advisable.

1.6. Construction Phase Services.

During the Construction Phase GEOTECHNICAL ENGINEER shall:

1.6.1. Consult with and advise ENGINEER concerning geotechnical considerations affecting construction.

1.6.2. In connection with observations of the geotechnical aspects of the work of Contractor(s) while it is in progress:

1.6.2.1. Make visits to the site at intervals appropriate to the various stages of construction as GEOTECHNICAL ENGINEER deems necessary, or as ENGINEER may request, in order to observe as an experienced and qualified professional geotechnical engineer the conditions encountered by Contractor(s) and the progress and quality of the geotechnical aspects of Contractor's work. Based on information obtained during such visits and on such observations, GEOTECHNICAL ENGINEER shall endeavor to determine in general if such conditions are as foreseen in the design and if such work is proceeding in accordance with the Contract Documents and shall keep ENGINEER informed of the progress of the work on the geotechnical aspects of the Project.

1.6.2.2. The purpose of GEOTECHNICAL ENGINEER's visits to the site will be to enable GEOTECHNICAL ENGINEER to better carry out the duties and responsibilities assigned to and undertaken by GEOTECHNICAL ENGINEER during the Construction Phase, and, in addition, by exercise of GEOTECHNICAL ENGINEER's efforts as an experienced and qualified professional geotechnical engineer, to provide for OWNER and ENGINEER a greater degree of confidence that the completed work of Contractor on the geotechnical aspects of the Project will conform generally to the Contract Documents and that the integrity of the design concept as reflected in the said Contract Documents has been implemented and preserved by Contractor. On the other hand, GEOTECHNICAL ENGINEER shall not, during such visits or as a result of such observations of Contractor's work in progress, supervise, direct or have control over Contractor's work nor shall GEOTECHNICAL ENGINEER have authority over or responsibility for the means, methods, techniques, sequences or procedures of construction selected by Contractor for the geotechnical aspects of the Project, for safety precautions and programs incident to said work of Contractor

or for any failure of Contractor to comply with laws, rules, regulations, ordinances, codes or orders applicable to Contractor furnishing and performing its work. Accordingly, GEOTECHNICAL ENGINEER can neither guarantee the performance of the construction contract by Contractor nor assume responsibility for Contractor's failure to furnish and perform its work in accordance with the Contract Documents.

1.6.3. *Defective Work.* During such visits and on the basis of such observations, GEOTECHNICAL ENGINEER shall consider the acceptability of the geotechnical aspects of Contractor's work while it is in progress, and shall consult with and advise ENGINEER whenever GEOTECHNICAL ENGINEER believes that such work will not produce the geotechnical aspects of the Project in general conformity with the Contract Documents or that such work will prejudice the integrity of the design concept of the geotechnical aspects of the Project as reflected in the Contract Documents.

1.6.4. Collect such samples and perform such tests as are described in Exhibit EG-B "Further Description of Basic Services and Related Matters" or required to check the Contractor(s) work for compliance with the Contract Documents as provided in paragraph 1.6.2. Samples will be preserved in accordance with paragraph 1.2.5.

1.6.5. Advise ENGINEER concerning special monitoring, testing or redesign required because of unforeseen conditions encountered during construction.

1.6.6. Communicate with Contractor(s) only through, or with the knowledge of, ENGINEER.

SECTION 2—ADDITIONAL SERVICES OF GEOTECHNICAL ENGINEER

2.1. General.

If authorized in writing by ENGINEER, GEOTECHNICAL ENGINEER shall furnish additional geotechnical services of the types listed in paragraphs 2.2 through 2.4 inclusive. These services are not included as part of Basic Services except to the extent provided otherwise in Exhibit EG-B "Further Description of Basic Services and Related Matters". Authorized Additional Services shall be paid for by ENGINEER as indicated in Section 5.

2.2. Services beyond the scope of Basic Services defined in Exhibit EG-B "Further Description of Basic Services and Related Matters", such as additional field explorations, laboratory testing, analyses, consultations, reviews or monitoring.

2.3. Services in connection with unforeseen conditions encountered during construction such as assistance to ENGINEER in any redesign, work directive changes or change orders.

2.4. Services during out-of-town travel required of GEOTECHNICAL ENGINEER other than visits to the site and the offices of OWNER and ENGINEER in connection with services required by Section 1.

2.5. Preparing to serve or serving as a consultant or witness for ENGINEER or OWNER in any litigation, arbitration or other legal or administrative proceeding involving the Project.

~~2.6. Resident Services during construction to provide more extensive on-site assistance to ENGINEER.~~

SECTION 3—ENGINEER'S RESPONSIBILITIES

ENGINEER shall do the following in a timely manner so as not to delay the services of GEOTECHNICAL ENGINEER.

3.1. Provide all information known to ENGINEER concerning the Project which ENGINEER and GEOTECHNICAL ENGINEER consider pertinent to GEOTECHNICAL ENGINEER's services, including, but not limited to, types of structures, structural loads, loads to be transferred to the soil and performance characteristics desired for the foundations, design objectives and constraints, space, capacity, flexibility and expendability, budgetary limitations, and such design and construction standards as OWNER or ENGINEER may require in connection with the Project, as well as geotechnical data, analyses and reports concerning the site.

3.2. Request from OWNER at OWNER's expense and furnish to GEOTECHNICAL ENGINEER, as required for performance of GEOTECHNICAL ENGINEER's Basic Services, data prepared by or services of others, including without limitation property, boundary, easement, right-of-way, topographic and utility surveys with descriptions and known restrictions, and other special data; all of which GEOTECHNICAL ENGINEER may rely upon in performing services hereunder.

3.3. Make available to GEOTECHNICAL ENGINEER all information obtained from OWNER or which ENGINEER knows is reasonably available and which ENGINEER and GEOTECHNICAL ENGINEER consider pertinent concerning the location of underground services, conduits, pipes, tanks and other obstructions.

3.4. Request OWNER to provide engineering surveys to establish reference points and base lines to enable GEOTECHNICAL ENGINEER to define the locations and elevations of field explorations and tests.

3.5. Request OWNER to arrange for access to and assist in making provisions for GEOTECHNICAL ENGINEER to enter upon public and private property as required for GEOTECHNICAL ENGINEER to perform services under this Agreement.

3.6. Designate in writing a person to act as ENGINEER's representative with respect to GEOTECHNICAL ENGINEER's services to be rendered under this Agreement. Such person shall have complete authority, in consultation with OWNER when appropriate, to transmit instructions, receive information, interpret and define ENGINEER's policies and decisions with respect to GEOTECHNICAL ENGINEER's services.

3.7. Furnish as set forth in Exhibit EG-B "Further Description of Basic Services and Related Matters", a representative at the site to coordinate the field explorations with Project needs and assist GEOTECHNICAL ENGINEER in locating field explorations and tests.

~~3.8. Give prompt written notice to GEOTECHNICAL ENGINEER of the date scheduled for the start of construction activities affected by geotechnical consideration.~~

3.9. Give prompt written notice to GEOTECHNICAL ENGINEER whenever ENGINEER observes or otherwise becomes aware of any development that affects the scope or timing of GEOTECHNICAL ENGINEER's services, or any defect or non-conformance in the work of the Contractor(s) affecting the geotechnical aspects of the Project.

3.10. Advise GEOTECHNICAL ENGINEER of the identity of other independent professional associates or consultants participating in the design or administration of the geotechnical aspects of the Project.

SECTION 4—PERIOD OF SERVICE

4.1. The provisions of this Section 4 and the rates of compensation for GEOTECHNICAL ENGINEER's services provided for elsewhere in this Agreement have been agreed to in anticipation of the orderly and continuous progress through completion of the geotechnical aspects of the Project. GEOTECHNICAL ENGINEER's obligation to render services hereunder shall extend for a period which may reasonably be required for the design and construction of the Project including extra work and required extensions thereto. GEOTECHNICAL ENGINEER recognizes that the services of ENGINEER and others involved in the Project are dependent upon the timely performance of geotechnical engineering services. Unless otherwise provided in Exhibit EG-B "Further Description of Basic Services and Related Matters" or elsewhere in this Agreement, GEOTECHNICAL ENGINEER shall perform such services in the same character, timing and sequence as ENGINEER is required to perform services under the Prime Agreement. If in Exhibit EG-B "Further Description of Basic Services and Related Matters" specific periods of time for rendering services are set forth or specific dates by which services are to be completed are provided, and if such time periods or dates are exceeded through no fault of GEOTECHNICAL ENGINEER, all rates, measures

and amounts of compensation provided herein shall be subject to equitable adjustment.

4.2. The field explorations, tests and analyses will be completed and the Report submitted within the period stipulated in Exhibit EG-B "Further Description of Basic Services and Related Matters".

4.3. After acceptance by ENGINEER of the Report, GEOTECHNICAL ENGINEER shall proceed with consultations and review of the geotechnical aspects of ENGINEER's study, design and proposed Contract Documents and shall continue these services for such time as reasonably required.

4.4. Construction phase services will commence with the start of construction activities affected by geotechnical considerations and will terminate upon ENGINEER's written recommendation of final payment to the Contractor(s). The date by or period of time within which GEOTECHNICAL ENGINEER's services during the Construction Phase are expected to be completed is set forth in Exhibit EG-B "Further Description of Basic Services and Related Matters".

4.5. If OWNER or ENGINEER suspends services, requests significant modifications or changes in the extent of the Project, authorizes Additional Services, or if progress is delayed through no fault of GEOTECHNICAL ENGINEER, the time of performance of GEOTECHNICAL ENGINEER's services shall be adjusted appropriately.

4.6. If field explorations, tests, analyses, or the Report, as required by Section 1, are delayed or suspended in whole or in part by OWNER or ENGINEER for reasons beyond GEOTECHNICAL ENGINEER's control, or if the schedule of construction activities affected by geotechnical considerations is delayed for reasons beyond GEOTECHNICAL ENGINEER's control, GEOTECHNICAL ENGINEER shall on written demand to ENGINEER be reimbursed as provided in paragraph 5.3.2. If such delay or suspension extends for more than one year for reasons beyond GEOTECHNICAL ENGINEER's control, or if GEOTECHNICAL ENGINEER for any reason is required to render services more than one year after Substantial Completion of the geotechnical aspects of the Project, all rates, measures and amounts of compensation provided herein shall be subject to equitable adjustment.

SECTION 5—PAYMENTS TO GEOTECHNICAL ENGINEER

5.1. Methods of Payment for Services of GEOTECHNICAL ENGINEER.

5.1.1. *For Basic Services.* ENGINEER shall pay GEOTECHNICAL ENGINEER for all Basic Services rendered under Section 1 (as amended and supplemented by Exhibit

EG-B "Further Description of Basic Services and Related Matters") as follows:

5.1.1.1. In accordance with the schedules of personnel and equipment charges shown in Exhibit EG-B "Further Description of Basic Services and Related Matters".

~~5.1.1.1. On the basis of a \$_____ lump sum.~~

~~5.1.1.1. On the basis of GEOTECHNICAL ENGINEER's Direct Labor Costs times a factor of _____ for all Basic Services rendered by principals and employees engaged directly on the Project, plus costs shown in Exhibit EG-B "Further Description of Basic Services and Related Matters".~~

~~5.1.1.1. On the basis set forth in Exhibit EG-B "Further Description of Basic Services and Related Matters".~~

5.1.2. *For Additional Services.* ENGINEER shall pay GEOTECHNICAL ENGINEER for Additional Services rendered under Section 2 as follows:

5.1.2.1. *General.* For Additional Services of GEOTECHNICAL ENGINEER's principals and employees engaged directly on the Project and rendered pursuant to Section 2 (except Resident Services under paragraph 2.6 and services as consultant or witness under paragraph 2.4) on the basis of the schedules of personnel and equipment charges shown in Exhibit EG-B "Further Description of Basic Services and Related Matters".

~~5.1.2.2. *Resident Services.* For Resident Services furnished as provided in paragraph 2.6 on the basis of the personnel and equipment charges shown in Exhibit EG-B "Further Description of Basic Services and Related Matters" for Resident Services.~~

~~5.1.2.3. *Serving as a Witness.* For services rendered by GEOTECHNICAL ENGINEER's principals and employees as consultants or witnesses as in any litigation, arbitration or other legal or administrative proceeding as provided in paragraph 2.4 at the rate shown in Exhibit EG-B "Further Description of Basic Services and Related Matters" for each day or any portion thereof (but compensation for time spent in preparing to appear in any such litigation, arbitration or proceeding will be on the basis provided in paragraph 5.1.2.1).~~

5.1.3. *Reimbursable Expenses.* In addition to the payments provided for in paragraphs 5.1.1 and 5.1.2, ENGINEER shall pay GEOTECHNICAL ENGINEER the actual costs (except where specifically provided otherwise) of all Reimbursable Expenses incurred in connection with all Basic Services and Additional Services.

5.1.4. Definitions.

5.1.4.1. Direct Labor Costs used as a basis for payment mean salaries and wages (basic and incentive) paid to all GEOTECHNICAL ENGINEER's personnel engaged directly on the Project, including, but not limited to, engineers, geol-

ogists, drillers, laboratory technicians, other technical and business personnel; but does not include indirect payroll related costs or fringe benefits. ~~For the purposes of this Agreement, the principals of GEOTECHNICAL ENGINEER and their current hourly Direct Labor Costs are:~~

The hourly Direct Labor Costs of principals of GEOTECHNICAL ENGINEER will be adjusted equitably to reflect changes in personnel and in GEOTECHNICAL ENGINEER's overall compensation procedures and practices.

5.1.4.2. Reimbursable Expenses mean the actual expenses incurred by GEOTECHNICAL ENGINEER directly or indirectly in connection with the geotechnical aspects of the Project, such as expenses for: transportation and subsistence incidental thereto; obtaining bids or proposals from contractors; providing and maintaining field office and field laboratory facilities including furnishings, laboratory equipment and supplies, and utilities; subsistence and transportation of Resident Project Representatives and their assistants; toll telephone calls and telegrams; reproduction of reports; Drawings, Specifications, Bidding Documents and similar Project-related items in addition to those required under Section 1; and if authorized in advance by ENGINEER, overtime work requiring higher than regular rates. In addition, if authorized in advance by ENGINEER, Reimbursable Expenses will also include expenses incurred for computer time and other highly specialized equipment, including an appropriate charge for previously established programs and expenses of photographic production techniques, times a factor of .

5.2. Times of Payments.

5.2.1. Except when provided otherwise in Exhibit EG-B "Further Description of Basic Services and Related Matters", GEOTECHNICAL ENGINEER shall submit monthly statements for Basic and Additional Services rendered and for Reimbursable Expenses incurred. The statements will be based upon the total services actually completed and Reimbursable Expenses incurred at the time of billing. If ENGINEER objects to any statement submitted, ENGINEER shall so advise GEOTECHNICAL ENGINEER in writing giving reasons therefor within fourteen days of receipt of such statement. If no such objection is made, the statement will be considered acceptable to ENGINEER.

5.2.2. ENGINEER shall bill OWNER monthly on account of GEOTECHNICAL ENGINEER's services and expenses and shall pay GEOTECHNICAL ENGINEER within fourteen days of the time ENGINEER receives payment from OWNER on account thereof. It is intended that payments to GEOTECHNICAL ENGINEER will be made as ENGINEER is paid by OWNER under the Prime Agreement and that ENGINEER shall exert reasonable and diligent efforts

to collect prompt payment from OWNER. However, whether or not OWNER pays ENGINEER in full, ENGINEER shall pay all amounts due GEOTECHNICAL ENGINEER within a reasonable time after completion of ENGINEER's services under the Prime Agreement.

5.3. Other Provisions Concerning Payments.

5.3.1. If ENGINEER has received an acceptable statement from GEOTECHNICAL ENGINEER (as provided in paragraph 5.2.1) for services and expenses and if thereafter ENGINEER fails to pay GEOTECHNICAL ENGINEER for the services and expenses covered by such statement (i) within fourteen days after receipt of payment from OWNER for such services and expenses (as provided in paragraph 5.2.2) or (ii) within sixty days after receipt of said acceptable statement from GEOTECHNICAL ENGINEER, then after said fourteenth or sixtieth day, whichever occurs first, (a) the amounts covered by such statement will be increased at the rate of 1% per month from the date which first occurs, and (b) GEOTECHNICAL ENGINEER may, after giving seven days' written notice to ENGINEER, suspend services under this Agreement until payment in full of all amounts covered by GEOTECHNICAL ENGINEER's acceptable statements for services and expenses.

5.3.2. ENGINEER shall reimburse GEOTECHNICAL ENGINEER for all direct expenses of demobilization and remobilization resulting from any suspension of services by GEOTECHNICAL ENGINEER in accordance with paragraph 5.3.1, or from any delay caused or any suspension ordered by OWNER or ENGINEER in accordance with paragraph 4.6.

5.3.3. If this Agreement is terminated prior to the completion of Basic Services and ENGINEER has received an acceptable statement from GEOTECHNICAL ENGINEER (as provided in paragraph 5.2.1), GEOTECHNICAL ENGINEER will be paid on the basis shown in Exhibit EG-B "Further Description of Basic Services and Related Matters" for all unpaid Basic and Additional Services performed to the date of termination and for completion of analyses, records and written report as provided in paragraph 6.3, plus all unpaid Reimbursable Expenses incurred to the date of termination. Except where termination is by ENGINEER in accordance with paragraph 6.2.1, GEOTECHNICAL ENGINEER will also be paid for all additional Reimbursable Expenses incurred after termination which are directly attributable to termination.

5.3.4. Whenever a factor is applied to Direct Labor Costs in determining compensation payable to GEOTECHNICAL ENGINEER, that factor will be adjusted periodically and equitably to reflect changes in the various elements that comprise such factor. All such adjustments will be in accordance with generally accepted accounting practices as applied on a consistent basis by GEOTECHNICAL ENGINEER and consistent with GEOTECHNICAL ENGINEER's overall compensation practices and procedures.

SECTION 6—GENERAL CONSIDERATIONS

6.1. Controlling Law.

This Agreement is to be governed by the law of the principal place of business of ENGINEER.

6.2. Termination.

6.2.1. The obligation to provide further services under this Agreement may be terminated by either party upon thirty days' written notice in the event of substantial failure by the other party to perform in accordance with the terms hereof through no fault of the terminating party.

6.2.2. This Agreement will terminate automatically upon termination of the Prime Agreement. ENGINEER will notify GEOTECHNICAL ENGINEER promptly of such termination.

6.3. Completion of Records.

In the event of termination by either party prior to completion of Basic Services GEOTECHNICAL ENGINEER shall complete such analyses and records as are necessary to complete GEOTECHNICAL ENGINEER's files and present to ENGINEER a written report on the services performed to the date of notice of termination.

6.4. Retention of Records.

GEOTECHNICAL ENGINEER shall retain all boring logs, field data, laboratory test data, calculations, notes and other records (except cost records) related to the Project in legible form for a period of five years following the completion or termination of services under this Agreement. Copies of such records will be made available to OWNER or ENGINEER upon request at the cost of reproduction.

6.5. Fiscal Records.

Fiscal records of GEOTECHNICAL ENGINEER's costs and expenses pertaining to the Project will be kept on a generally recognized accounting basis and made available on ENGINEER's request for examination and audit, and as required by the Prime Agreement.

6.6. Reuse of Documents.

All documents prepared or furnished by GEOTECHNICAL ENGINEER (and GEOTECHNICAL ENGINEER's independent professional associates and consultants) pursuant to this Agreement are instruments of service in respect of the Project and GEOTECHNICAL ENGINEER shall retain an ownership and property interest therein whether or not the Project is completed. ENGINEER and OWNER may make and retain copies for information and reference in connection with the use and occupancy of the Project by OWNER and others; however, such documents are not intended or rep-

resented to be suitable for reuse by OWNER. ENGINEER or others on extensions or modifications of the Project or on any other project. Any such reuse without written verification or adaptation by GEOTECHNICAL ENGINEER for the specific purpose intended will be at the user's sole risk and without liability or legal exposure to GEOTECHNICAL ENGINEER; and ENGINEER shall indemnify and hold harmless GEOTECHNICAL ENGINEER from all claims, damages, losses and expenses including attorneys' fees arising out of or resulting from ENGINEER's reuse without such adaptation or verification. Any such verification or adaptation will entitle GEOTECHNICAL ENGINEER to further compensation at rates to be agreed upon by ENGINEER and GEOTECHNICAL ENGINEER.

6.7. Opinions of Cost.

Since GEOTECHNICAL ENGINEER has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, any opinions of probable construction cost presented by GEOTECHNICAL ENGINEER, or comments on opinions of probable construction cost or estimates of others, are to be made on the basis of GEOTECHNICAL ENGINEER's experience as a qualified professional engineer, familiar with the construction industry; but GEOTECHNICAL ENGINEER cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions of probable cost presented.

6.8. Insurance.

6.8.1. ENGINEER and GEOTECHNICAL ENGINEER shall each procure and maintain insurance for protection from claims under workers' compensation acts, claims for damages because of bodily injury including personal injury, sickness or disease or death of any and all employees or of any person other than such employees, and from claims for damages because of injury to or destruction of property including loss of use resulting therefrom, and any other insurance prescribed by law, required by the Prime Agreement, or required by ENGINEER, as set forth in Exhibit EG-B "Further Description of Basic Services and Related Matters"; and certificates indicating such insurance is in effect shall be exchanged by them.

6.8.2. ENGINEER will also cause other independent professional associates and consultants retained by ENGINEER for the Project to procure and maintain comparable insurance coverage.

6.9. Professional Liability.

GEOTECHNICAL ENGINEER shall perform the services under this Agreement with the care and skill ordinarily used by members of the profession practicing under similar conditions at the same time and in the same or a similar locality. ENGINEER and GEOTECHNICAL ENGINEER agree that subsurface conditions may vary from those encountered in borings, surveys or explorations, and that conclusions must

be based upon such information as is available. However, GEOTECHNICAL ENGINEER shall be liable for the results of professional errors, omissions or negligence of GEOTECHNICAL ENGINEER in the performance of services under this Agreement.

6.10. Successors and Assigns.

6.10.1. ENGINEER and GEOTECHNICAL ENGINEER each is hereby bound and the partners, successors, executors, administrators and legal representatives of ENGINEER and GEOTECHNICAL ENGINEER (and to the extent permitted by paragraph 6.10.2 the assigns of ENGINEER and GEOTECHNICAL ENGINEER) are hereby bound to the other party to this Agreement and to the partners, successors, executors, administrators and legal representatives (and said assigns) of such other party, in respect of all covenants, agreements and obligations of this Agreement.

6.10.2. Neither ENGINEER nor GEOTECHNICAL ENGINEER shall assign, sublet or transfer any rights under

or interest in this Agreement (including, but without limitation, moneys that may become due or moneys that are due) without the written consent of the other, except to the extent that any assignment, subletting or transfer is mandated by law or the effect of this limitation may be restricted by law. Unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under this Agreement. Nothing contained in this paragraph shall prevent GEOTECHNICAL ENGINEER from employing such independent professional associates and consultants or subcontractors GEOTECHNICAL ENGINEER may deem appropriate to assist in the performance of services hereunder.

6.10.3. Nothing under this Agreement shall be construed to give any rights or benefits in this Agreement to anyone other than ENGINEER and GEOTECHNICAL ENGINEER and all duties and responsibilities undertaken pursuant to this Agreement will be for the sole benefit of ENGINEER and GEOTECHNICAL ENGINEER and not for the benefit of any other party.

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6.11. Arbitration.

6.11.1. All claims, counterclaims, disputes and other matters in question between the parties hereto arising out of or relating to this Agreement or the breach thereof will be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining, subject to the limitations and restrictions stated in paragraphs 6.11.3 and 6.11.4 below. This agreement so to arbitrate and any other agreement or consent to arbitrate entered into in accordance herewith as provided in this paragraph 6.11 will be specifically enforceable under the prevailing arbitration law of any court having jurisdiction.

6.11.2. Notice of demand for arbitration must be filed in writing with the other parties to this Agreement and with the American Arbitration Association. The demand must be made within a reasonable time after the claim, dispute or other matter in question has arisen. In no event may the demand for arbitration be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would be barred by the applicable statute of limitations.

6.11.3. All demands for arbitration and all answering statements thereto which include any monetary claim must contain a statement that the total sum or value in controversy as alleged by the party making such demand or answering statement is not more than \$200,000 (exclusive of interest and costs); and the arbitrators will not have jurisdiction, power or authority to render a monetary award in response thereto against any party which totals more than \$200,000 (exclusive

of interest and costs). The arbitrators will not have jurisdiction, power or authority to consider, or make findings (except in denial of their own jurisdiction) concerning any claim, counterclaim, dispute or other matter in question where the amount in controversy of any such claim, counterclaim, dispute or matter is more than \$200,000 (exclusive of interest and costs).

6.11.4. No arbitration arising out of, or relating to, this Agreement may include, by consolidation, joinder or in any other manner, any person or entity who is not a party to this Agreement.

6.11.5. By written consent signed by all the parties to this Agreement and containing a specific reference hereto, the limitations and restrictions contained in paragraphs 6.11.3 and 6.11.4 may be waived in whole or in part as to any claim, counterclaim, dispute or other matter specifically described in such consent. No consent to arbitration in respect of a specifically described claim, counterclaim, dispute or other matter in question will constitute consent to arbitrate any other claim, counterclaim, dispute or other matter in question which is not specifically described in such consent or in which the sum or value in controversy exceeds \$200,000 (exclusive of interest and costs) or which is with any party not specifically described therein.

6.11.6. The award rendered by the arbitrators will be final, judgment may be entered upon it in any court having jurisdiction thereof, and will not be subject to modification or appeal except to the extent permitted by Sections 10 and 11 of the Federal Arbitration Act (9 U.S.C. §§10, 11).

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SECTION 7—SPECIAL PROVISIONS, EXHIBITS AND SCHEDULES

7.1. This Agreement is subject to the following special provisions.

7.1.1.

7.2. The following exhibits and schedules are attached to and made a part of this Agreement:

7.2.1. Exhibit EG-A—Pertinent portions of the Prime Agreement.

7.2.2. Exhibit EG-B—“Further Description of Basic Services and Related Matters” (pages 1 to ____, inclusive).

7.2.3.

7.2.4.

7.2.5.

7.3. This Agreement (consisting of pages 1 to ____, inclusive), together with the exhibits and schedules identified above constitute the entire agreement between ENGINEER and GEOTECHNICAL ENGINEER and supersede all prior written or oral understandings. This Agreement and said exhibits and schedules may only be amended, supplemented, modified or cancelled by a duly executed written instrument.

IN WITNESS WHEREOF, the parties hereto have made and executed this Agreement as of the day and year first above written.

ENGINEER:

Address for Giving Notices:

GEOTECHNICAL ENGINEER:

Address for Giving Notices:

EXHIBIT EG-B TO AGREEMENT BETWEEN ENGINEER
AND GEOTECHNICAL ENGINEER FOR PROFESSIONAL
SERVICES dated _____
19__ (for use with No. 1910-27-B.1986 ed.)

Further Description of Basic Services and Related Matters

1. This is an exhibit attached to and made a part of the Agreement made on _____, 19__ between Donohue & Associates, Inc. (ENGINEER) and _____ (GEOTECHNICAL ENGINEER) providing for professional engineering services. The Basic Services of GEOTECHNICAL ENGINEER as described in Section 1 of the agreement are amended or supplemented as indicated below and the time periods for the performance of certain services as indicated in Section 4 of the Agreement are stipulated as indicated below.

(delete "personnel and" when appropriate; add applicable schedules)

1. GEOTECHNICAL ENGINEER shall procure and maintain insurance in accordance with paragraph 6.8 as follows:

Consultant shall secure and maintain throughout the duration of this agreement, insurance of such types and in such amounts as may be necessary to protect its interests against all hazards or risks of loss as hereinafter specified. The form and limits of such insurance, together with the underwriter thereof in each instance, shall be acceptable to the Engineer. Certificates of Insurance shall be filed with the Engineer prior to starting any work under this agreement. The certificates shall contain a provision that not less than 30 days written notice will be given to the Engineer before any policy or coverage is changed or cancelled. The Engineer shall be named as an additional insured in each of such policies. Without limiting the requirements hereinbefore set forth, the insurance coverages shall include a minimum of:

1. Worker's compensation and employers liability insurance as required by the State of Wisconsin.
2. Comprehensive automobile and vehicle liability shall be written in comprehensive form, shall protect the Engineer against claims for injuries to members of the public and/or damage to property of others arising from the Geotechnical Engineer's use of motor vehicles or any other equipment, and shall cover operation with respect to all on- off-site operations under this subagreement. All such insurance coverage shall extend to any motor vehicles or other equipment irrespective of whether the same is owned, nonowned, or hired. The limits of liability shall not be less than the following:

Bodily injury	\$250,000.00 each person \$500,000.00 each occurrence
Property damage	\$100,000.00 each occurrence

3. Comprehensive general liability. This insurance shall be written in comprehensive form, shall include Owner's protective liability insurance, and shall protect the Geotechnical Engineer and Engineer against claims arising from injuries to members of the public or damage to property of others arising out of any acts or omission of the Geotechnical Engineer or of any of its agents, employees, or subcontractors. The limits of liability shall not be less than the following:

Bodily	
Personal injury	\$300,000.00 each occurrence \$500,000.00 aggregate
Property damage	\$100,000.00 each occurrence \$200,000.00 aggregate

4. Professional liability insurance. This insurance will be required for projects in which the Geotechnical Engineer Consultant or his subcontractor is required to provide laboratory or field soil tests, rock testing, interpretations of soil and/or rock stratigraphic sequences, interpretations of soil properties, or provide professional recommendations based on the testing or interpretations noted above to the Project Owner or Engineer for construction or other purposes. Professional liability insurance shall be written insuring payment of damages for legal liability arising out of the performance of professional services for the Engineer in the insured's capacity as Geotechnical Engineer if such legal liability is caused by an error, omission, or negligent act of the insured or of any person or organization for whom the insured is legally liable. The limits of liability shall not be less than \$350,000.

- Professional liability insurance is required for this project.

- Professional liability insurance is required for this project.

The insurance coverages specified in 1, 2, 3, and 4 above shall constitute minimum requirements, and the Engineer shall be named as co-insured or additional insured in insurance coverages 2 and 3.

TR/MISC/KW7

PART II BID FORM

COST BREAKDOWN FOR SOILS INVESTIGATION

Site: USARC Training Area - 84th Division
Milwaukee, Wisconsin

<u>Item</u>	<u>Estimated Quantity</u>	<u>Unit Cost</u>	<u>Extension</u>
1. MOBILIZATION	Lump Sum		
2. PER DIEM EXPENSES	5 days		
3. PROJECT COORD. & REPORT	Lump Sum		
4. HEALTH & SAFETY PLAN	4 hours		
5. SOIL BORING (includes SPT, sampling at 5-foot intervals)			
A. Observation Wells (2)			
1. 0-20 foot depth		40 feet	
B. Intermediate Piezometers (2)			
1. 0-20 foot depth		40 feet	
2. 20-40 foot depth		40 feet	
3. 40-50 foot depth		10 feet	
6. ROCK CORING			
1. 40-50 foot depth			
7. WELL CONSTRUCTION	4 wells		
All materials/labor asso- ciated with well installa- tion including riser, screen, seals, filterpack and grout.	(130 feet)		
8. WELL PROTECTION	4 wells		
a. All materials/labor associated with well protection including concrete collar and protector top.			
b. Flush-mount locking caps	2 wells		

SUBTOTAL \$ _____

PART II - BID FORM

COST BREAKDOWN FOR SOILS INVESTIGATION
(Continued)

Site: USARC Training Area - 84th Division
Milwaukee, Wisconsin

<u>Item</u>	<u>Esti- mated Quantity</u>	<u>Unit Cost</u>	<u>Extension</u>
9. GEOTECHNICAL TESTING (as directed)			
A. Sieve Analysis - ASTM D422	2 samples		
B. Atterberg Limits - ASTM D4318, D423 & D424	2 samples		
C. Moisture content ASTM D2216	2 samples		
10. LEVEL D PROTECTION	5 days		
11. STEAM CLEANING	2 locations		
12. WELL DEVELOPMENT	4 wells		
13. SURVEYING & MONUMENTS	Lump Sum		
TOTAL ESTIMATED FEE			\$ _____

Note:

1. All quantities are estimated. The Engineer reserves the right to add or delete 25 percent of the quantities from the project without affecting the unit price. Any item may be deleted as directed by the Engineer.
2. All drilling costs to include the cost of using minimum 4-1/2 in. in dia. (8-7/8 in. O.D. dia.) hollow stem augers.
3. NX rock coring includes cost associated with reaming to minimum 4-in. diameter borehole.
4. Drill rig and equipment, and well screen and riser will be steam-cleaned and decontaminated before arrival on-site.

5. Per diem expenses are per two-man crew.
6. Well development assumes 2 hours per well.
7. Drilling activities include sampling. The number of samples have been determined by the Engineer.
8. Any changes or additions to this attachment shall be approved by the Engineer.

PART III

SPECIFICATIONS FOR SOIL BORING, ROCK DRILLING,
OBSERVATION WELL AND PIEZOMETER INSTALLATION,
AND WELL DEVELOPMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Description of Work:

1. Drill and log four (4) soil borings.
2. Install two (2) observation wells and two (2) intermediate piezometers.
3. Well development.
4. Survey newly-installed wells.

1.02 QUALITY ASSURANCE

A. Work shall be supervised by a professional experienced in installation of monitoring wells used to collect water quality data.

B. Reference Standards:

1. American Society for Testing and Materials (ASTM):
 - a. ASTM C33-83 - Specification for Concrete Aggregates.
 - b. ASTM C94-83 - Specification for Ready-Mixed Concrete.
 - c. ASTM C150-83A - Specification for Portland Cement.
 - d. ASTM D423-66 - Test Method for Liquid Limit of Soils.
 - e. ASTM D424-59 - Test Method for Plastic Limit and Plasticity Index of Soils.
 - f. ASTM D698-78 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 5.5-lb (2.49 kg) Rammer and 12-in. (304.8 mm) Drop.
 - g. ASTM D1452-80 - Practice for Soil Investigation and Sampling by Auger Borings.
 - h. ASTM D1557-78 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.54 kg) Rammer and 18-in. (457 mm) Drop.
 - i. ASTM D1586-67 - Method of Penetration Test and Split Barrel Sampling of Soils.
 - j. ASTM D1587-83 - Method for Thin-Walled Tube Sampling of Soils.

- k. ASTM D2113-83 - Method for Diamond Core Drilling for Site Investigation.
- l. ASTM D2434-68 - Test Method for Permeability of Granular Soils (Constant Head).
- m. ASTM D2487-83 - Classification of Soils for Engineering Purposes.
- n. ASTM D2488-69 - Recommended Practice for Description of Soils (Visual-Manual Procedure).
- o. ASTM D3385-75 - Standard Test Method for Infiltration Rate of Soils in Field using Double-Ring Infiltrometers.
- p. ASTM D420-69 (79) - Standard Recommended Practice for Investigating and Sampling Soil and Rock for Engineering Purposes.
- q. ASTM D653-85 - Terms and Symbols Relating to Soil and Rock.

1.03 SUBMITTALS

A. Final Boring Logs:

- 1. Final boring logs, based on field information and laboratory test results as required by the Engineer, shall be completed by the GEOTECHNICAL ENGINEER'S project geologist or engineer present during all drilling operations.
- 2. Submit chart illustrating soil classification criteria, terminology, and symbols.
- 3. Submit within 30 working days after drilling is completed.

B. Laboratory Results:

- 1. Submit within 30 working days after drilling is completed.

C. Well construction diagrams.

D. Well development forms.

E. GEOTECHNICAL ENGINEER'S Health and Safety Plan.

F. Submit five copies of all submittals to ENGINEER.

PART 2 PRODUCTS

2.01 OBSERVATION WELLS

- A. Construct of 2-in. ID, Schedule 304, flush-threaded stainless steel riser pipe and screen (continuous wire-wound). Riser shall be supplied without ink labels.

B. Screen: Continuous "wire-wound" stainless, 0.010-inch.

1. Observation Wells: 10-ft screen length.

2. Piezometers: 5-ft screen length.

2.02 CONCRETE

A. Cement: ASTM C150, Type I, air-entrained.

B. Aggregate: Size No. 67, ASTM C33.

C. Minimum Compressive Strength: 3,500 psi at 28 days.

D. Concrete Mix: Measure and combine cement, aggregates, and water in accordance with ASTM C84.

2.03 FILTER PACK

A. Clean, well-rounded, well-sorted, washed quartz silica sand; No. 10 sieve.

B. 95% (by weight) greater than 0.010-inch slot screen; maximum size of 1/4-in., uniformity coefficient ≤ 2.5 .

2.04 SEALS

A. One-half inch diameter, bentonite pellets, free of additives.

2.05 GROUT

A. Sand-bentonite slurry comprised of pure bentonite (granular) mixed with 20 to 30% (by weight; sand to bentonite) fine sand and water until a mixed marsh funnel viscosity rated at 70 sec per quart, and a mud weight of at least 11 pounds per gallon is attained. Constituents comprising the slurry shall have the following relationship unless determined otherwise by the ENGINEER: 9 lbs bentonite: 2 lbs sand: 6 gallons water.

PART 3 EXECUTION

3.01 PREPARATION

A. Clear and grub site as directed by ENGINEER.

3.02 GENERAL

A. Perform auger borings in accordance with ASTM D1452.

- B. Unless otherwise stipulated, perform drilling and sampling in accordance with ASTM D1586 and D1587.
 - C. Perform rock coring in accordance with ASTM D2113.
- 3.03 DECONTAMINATION OF EQUIPMENT, DISPOSAL, AND PERSONNEL PROTECTION
- A. Decontamination of Equipment:
 - 1. Prior to mobilization of drill rig on-site, clean rig and associated equipment to remove items such as oil, grease, mud, and tar. Cleaning process consists of:
 - a. High-pressure, hot water cleaning.
 - 2. Sampling equipment shall be cleaned between samples with clean water. Rinse in order to minimize any cross-contamination. Before drilling each boring, clean augers, cutting bits, and drilling rods. Cleaning process includes:
 - a. High-pressure steam cleaning.
 - 3. Special cleaning attention should be given to threaded section of casing and drill rods. Do not use petroleum-based lubricants to prevent binding.
 - 4. Provide equipment necessary for cleaning process.
 - 5. Identify water source prior to drilling.
 - B. On-Site Safety:
 - 1. GEOTECHNICAL ENGINEER must agree to comply with requirements set forth in OSHA 29 CFR 1910.120, and confirm that personnel engaged in field activities are physically able to perform said work, and are in proper physical condition to utilize appropriate respiratory equipment in accordance with 29 CFR 1910.134 (b)10.
 - 2. Personnel employed or retained for services by ENGINEER may be required to wear personal protective clothing and respiratory protective equipment while drilling on- and off-site.
 - 3. The GEOTECHNICAL ENGINEER will provide a site-specific Health and Safety Plan (SSSP) to the ENGINEER. The GEOTECHNICAL ENGINEER will abide by this plan throughout the execution of the work. The Health and Safety Plan will be based on the best available background information.

- a. The GEOTECHNICAL ENGINEER will be responsible for monitoring on-site, real-time air monitoring during the drilling process, well installation and development process in the vicinity of the borehole to ensure that a safe level of protection for personnel is met. These readings will be recorded. Real-air quality monitoring equipment shall include, but is not limited to, portable photoionization units such as the HNU or PID, or equivalent, and a combustible gas indicator.
 - b. The GEOTECHNICAL ENGINEER shall immediately inform the ENGINEER if a change in on-site conditions may require a higher level of protection is detected. The work shall be stopped and health and safety practices reviewed prior to work continuation.
 - c. The GEOTECHNICAL ENGINEER is responsible for enduring his personnel's compliance with the Health and Safety Plan.
 - d. For those subcontractors' employees who will be participating in the project activities, the GEOTECHNICAL ENGINEER, upon request, will submit to Donohue for informational purposes and for the project files a copy of their SSSP along with verification of each employee's level of training, participation in a Medical Monitoring Program, and a copy of updated fit-test records.
4. Other protective equipment required to be furnished by GEOTECHNICAL ENGINEER, include:
- a. Chemically resistant coveralls.
 - b. Protective safety boots.
 - c. Hard hats.
 - d. Protective gloves.
 - e. Safety goggles.
 - f. Respiratory protection.

3.04 DRILLING

- A. Record measurements to nearest tenth of a foot.
- B. Record static water level after completion of drilling and sampling during drilling and sampling and 24 hrs after hole drilled.
- C. Classify soil and rock types using the USCS Classification System, and determine Rock Quality Designation of rock cores.

- D. Obtain soil samples and/or rock cutting at five (5)-foot depth increments at each new well location. In the case of a well nest, sample at five-foot depths in the deepest well. Sample the remaining wells comprising the well nest at the depth of well screen.
- E. Drill boring in unconsolidated formations with use of 4-in. diameter (minimum ID) hollow stem augers or casing. Borings not requiring sampling, and which do not cave may be drilled with 4-in. diameter (minimum) flight augers.
- F. If rock coring is required, utilize NX (or larger) size core bit. After coring, ream rock to minimum 4-in. diameter. Record water losses during drilling.
- G. Do not use drilling fluids other than water unless agreed upon by the ENGINEER. Notify ENGINEER prior to the use of any drilling fluids other than water. If mud is required, use pure bentonite as an additive.
- H. Well Depths:
 - 1. Observation Wells: Approximately 20 ft deep (as determined by the ENGINEER).
 - 2. Intermediate Piezometers: 20 ft below depth of well screen in observation well; approximately 45 ft deep.

3.05 SAMPLING

A. General:

- 1. Place samples in core trough for visual inspection. After logging, place selected samples in sample jars or wood core boxes.
- 2. Seal undisturbed samples with wax.
- 3. Clearly mark samples with sample number and depth, and project location.
- 4. Retain samples at GEOTECHNICAL ENGINEER'S office until notified by ENGINEER.

B. Soils:

- 1. Use standard 2-in. split barrel (split spoon) soil sampling system to obtain soil samples at 5-foot depth increments from the ground surface to the total depth of boring.

C. Rock Drilling (if necessary):

1. Use Tricone bit; minimum 2-1/2 in.-minimum diameter. Ream borehole to minimum 4-in. diameter.

D. Rock Coring (if necessary):

1. Use NX size core barrel (2-7/8 in. or larger). Ream borehole to minimum 4-in. diameter.

3.06 INSTALLATION

A. Wrap joints with teflon tape, if determined necessary by the ENGINEER.

B. Screen Section Backfill:

1. Backfill screened interval with No. 10 washed, quartz silica sand placed by gravity.
2. Extend sand pack to 2 ft above screen in observation wells, and 5 ft above screen in piezometers.
3. Calculate volume of annular space to be backfilled and compare to actual volumes used.
4. Measure depth to sand pack by direct method.

C. Bentonite Seal:

1. Use bentonite pellets for seal material where standing water is present in borehole.
2. Granular bentonite placed by tremie pipe may be used in dry boreholes.
3. Hydrate seals at least 1/2 hr before placement of overlying grout or concrete collar/cap.
4. Seals shall have a minimum thickness of 2 ft thick in observation wells, and 5 ft in piezometers.
5. Tamp seal material after placement and take direct measurement of depth.

D. Above Seal Backfill:

1. Backfill above bentonite seal to 7 ft below ground surface with sand-bentonite slurry with a mixed viscosity of 70 sec per quart.
2. Grout placement shall occur by using side-discharge tremie pipe placed 3 ft above seal and withdrawn as annular space fills.
3. Place 2 ft bentonite seal above grout which will be hydrated minimum of 1/2 hr before placement of concrete collar/cap.

E. Concrete Collar/Cap:

1. Place minimum 5-ft concrete collar/cap to ground surface.
2. Slope concrete away from well at surface.

F. Check installation for grout settlement approximately 24 hrs after well has been completed. If settlement has occurred such that level below existing grade, place additional concrete to create slightly mounded condition.

G. Well Protection:

1. Wells installed with well stick-up (above ground surface).
 - a. Place 5-ft minimum length, vented, protective pipe (4-inch min. dia.) with hinged, locking covers over well stick-up. Vent shall consist of a 1/2-inch dia. drain hole placed in protective pipe just above concrete cap. Use a vented, threaded plug for well cap.
 - b. Label well number on inside cover and outside of protective casing. Use non-fading permanent marker. Label in accordance with ENGINEER'S numbering system.
 - c. Provide keyed alike locks and keys for protective casing.
 - d. Provide guard posts as directed by the ENGINEER.
2. Wells installed to ground surface (flush-mounted).
 - a. Remove soil 18-inches away from well riser to 12-inch depth.
 - b. Cut well riser 6-inches below ground surface. Use a vented, threaded plug for well cap.
 - c. Place 2-foot minimum length, vented, protective pipe with hinged, locking covers over well riser, 4-inches below ground surface.
 - d. Complete well installation by installing a 12-inch steel locking well cover/collar at ground surface.

3.07 WELL DEVELOPMENT

A. Procedures and Reporting:

1. Record procedures used during well development or purging of drilling fluid from monitoring wells. Do not use surge blocks on observation wells.

2. Record equipment used for development. Include description of surge block, if used.
3. Perform development as soon as practical after well installation, but no sooner than 48 hrs after grouting completed. Accomplish development with pump and/or bottom discharge bailer, possibly supplemented with surge block until well water clear and sediment thickness within well is less than 5% of screen length.
4. As minimum, following volume shall be removed from wells:
 - a. For those wells where boring made without use of drilling fluid (mud and/or water), remove five times standing water volume in well. Standing water volume includes water volume within well screen and casing, plus saturated annulus.
 - b. For those wells where boring was made or enlarged with use of drilling fluid, remove five times standing water volume, plus the measured amount of drilling fluid lost during drilling.
 - c. Should water remain discolored after development, increase volume of water to ten times required volume as per above. If water still remains discolored, note this on well development forms and notify person in charge of investigation.
5. Do not add water to well to assist in well development. Do not use dispersing agents, acids or disinfectants.
6. During development, an effort should be made to remove standing water from both points near bottom of well screen and top of water column.

B. Development Form:

1. The following data should be recorded as part of development on the attached form (or suitable alternate):
 - a. Well number.
 - b. Dates and times of well development.
 - c. Static water level, depth to bottom of well before and after development, type and size of pump and/or bailer used.
 - d. Description of surge technique, if used.
 - e. Volume of water removed prior to each description of removed water.

- f. Physical characteristics of removed water to include clarity, color, odor, conductivity, pH, temperature, and physical description of removed sediments to include lithology and grain size. At minimum, these measurements shall be taken at start, during, and at conclusion of development.

3.08 CLEAN UP

- A. Level piles of earth resulting from drilling or other operations.
- B. Clean site of debris resulting from work.

3.09 SURVEY

- A. Survey coordinates shall be to the closest 1.0 foot referenced to the State Plane Coordinate System. If the State Plane Coordinate System is not readily available, an existing local grid system shall be used. A ground elevation to the closest 0.01 foot and elevation for the top of the casing to the closest 0.01 foot shall be obtained at each well. These elevations shall be referenced to the National Geodetic Vertical Datum of 1929. If the 1929 Datum is not readily available, the existing local vertical Datum shall be used.

One permanent control monument shall be placed in accessible location within the limits of the work. Coordinates and elevations shall be established to the closest 0.01 foot for the control monument. The location, identification, coordinates, and elevations of the wells and monument shall be plotted on maps with a scale large enough to show their locations with reference to other structures at the individual sites. A tabulated list of the observation wells and monument, copies of all field books, and all computation sheets shall be prepared and submitted to the ENGINEER. The tabulation shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations. These items shall be submitted to the ENGINEER no later than the 30 days after completion of the field survey.

M/P/IQ9

ATTACHMENT A
SITE LOCATION MAPS

ATTACHMENT B
WELL CONSTRUCTION

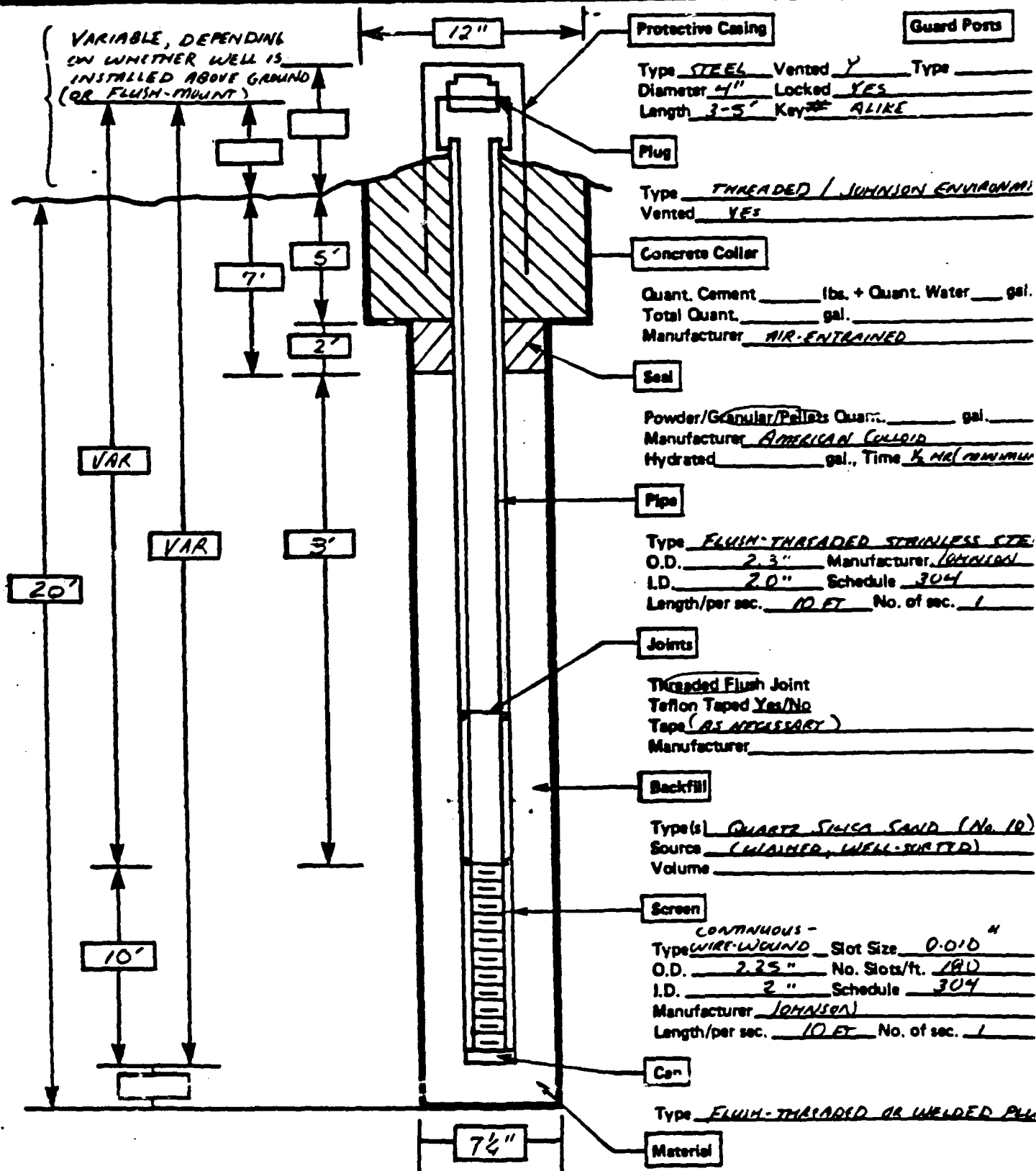
Donohue

OBSERVATION WELL INSTALLATION DIAGRAM

Site: USARC TRAINING AREA Date: NOVEMBER 1998

By: D. VOIGHT

Project No. 15977.007

Well No.


Donohue

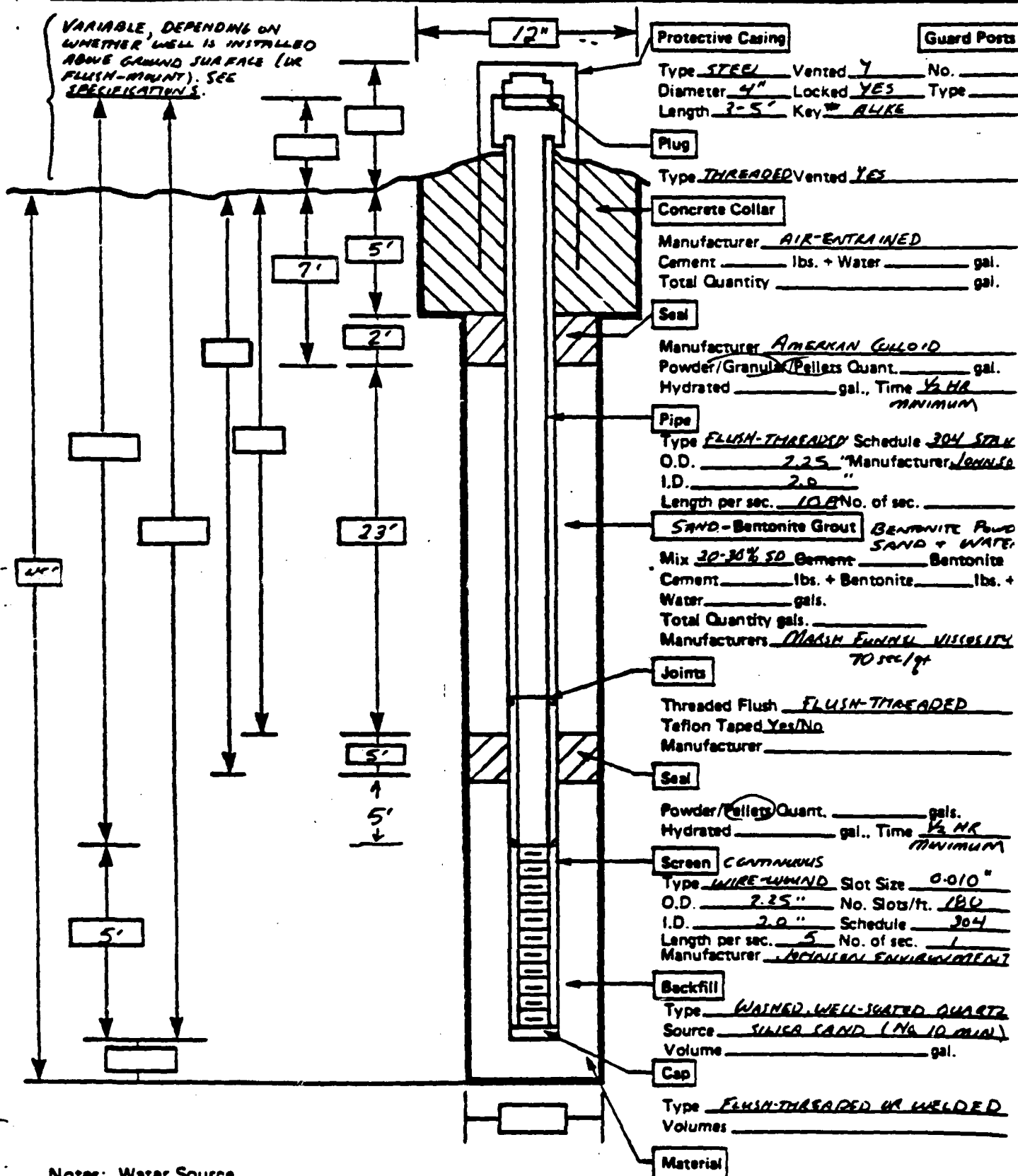
PIEZOMETER INSTALLATION DIAGRAM

Sheet ___ of ___

Well No. _____

Site: LISARC TRAINING AREADate: NOVEMBER, 1986By: D. VOLKERTProject No. 15977.007

VARIABLE, DEPENDING ON WHETHER WELL IS INSTALLED ABOVE GROUND SURFACE (OR FLUSH-MOUNT). SEE SPECIFICATIONS.



ATTACHMENT C
WELL DEVELOPMENT

Date